factory
MANAGEMENT AND MAINTENANCE

Vol. 95, No. 2 — February, 1937

CONTENTS

Labor Is Tipping the Apple Cart 33
An editorial

We're "Small Plant" and Like It 34
Too smart to want to get too big

No 30-Hour Week, But— 37
Some sort of regulation a foregone conclusion

Here Is Simple, Effective Handling 38
Big crane teams with little cranes

Our Second Motion-Study School 39
An advanced course—with all the reasons why

A Take-Away That's 99% Automatic 42
Flash removal problem neatly solved

Women Take Appearances Seriously 44
Out with khaki smocks, says Donald Laird

Measured Day Work 45
Pros and cons

Detroit Sends Its Foremen to School 47
Knows they must be better leaders

Better than a Bonus 49
Is this concern's profit-sharing plan

Eight Pieces of Paper Enough 50
Paperwork needed to run a furniture factory

Safety in 4 Acts 53
With the scene laid in a duPont plant

You Want to Know 54

It Paid to Revamp Our Power Drives ... 55
Simplicity, flexibility, economy the result

They Take Their Own Medicine 57

Standard Procedure for Mechanical Department 58
Bauer & Black puts it down in black and white

When Motor Starters Go Bad 61
There are ways to keep the wheels turning

How Long to Speed Up or Slow Down? .. 63
Formulas for acceleration and deceleration

Readers Want Answers 65

Operating Shorts

Time Meters to Find Refrigerating Costs 66
Box Reduces Mixing of Good Work with Bad. 66
Pneumatic-Tired Trucks Make Easy Handling. 67
Better Tests in Air-Conditioned Booths 67
Detector for Broken Carpet Needles 67
Conditioned Air Makes Better Electrodes 68

Answers to Questions 68

What's New in Equipment 69

Saying and Doing 82

Trade Literature 104

Books 108

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Factory Management and Maintenance is a consolidation of *Factory and Industrial Management* (including *"Factory"*) and *Maintenance Engineering*

Price 35c. a copy. Subscription rates—United States, Canada, Mexico and Central and South American countries, $3 a year. All other countries, $4 a year or 16 shillings. Cable address "McGrawhill, New York." Member of A.B.P. Member A.B.C. Copyright, 1937, by McGraw-Hill Publishing Co., Inc.

Factory Management and Maintenance, February, 1937. Vol. 95; No. 2. Published monthly. McGraw-Hill Publishing Company, Inc. Publication office, 99–129 North Broadway, Albany, N. Y. Editorial and executive offices, 330 West 42d Street, New York, N. Y. Entered as second class matter, November 13, 1936, at Post office, Albany, N. Y., under the Act of March 3, 1879.

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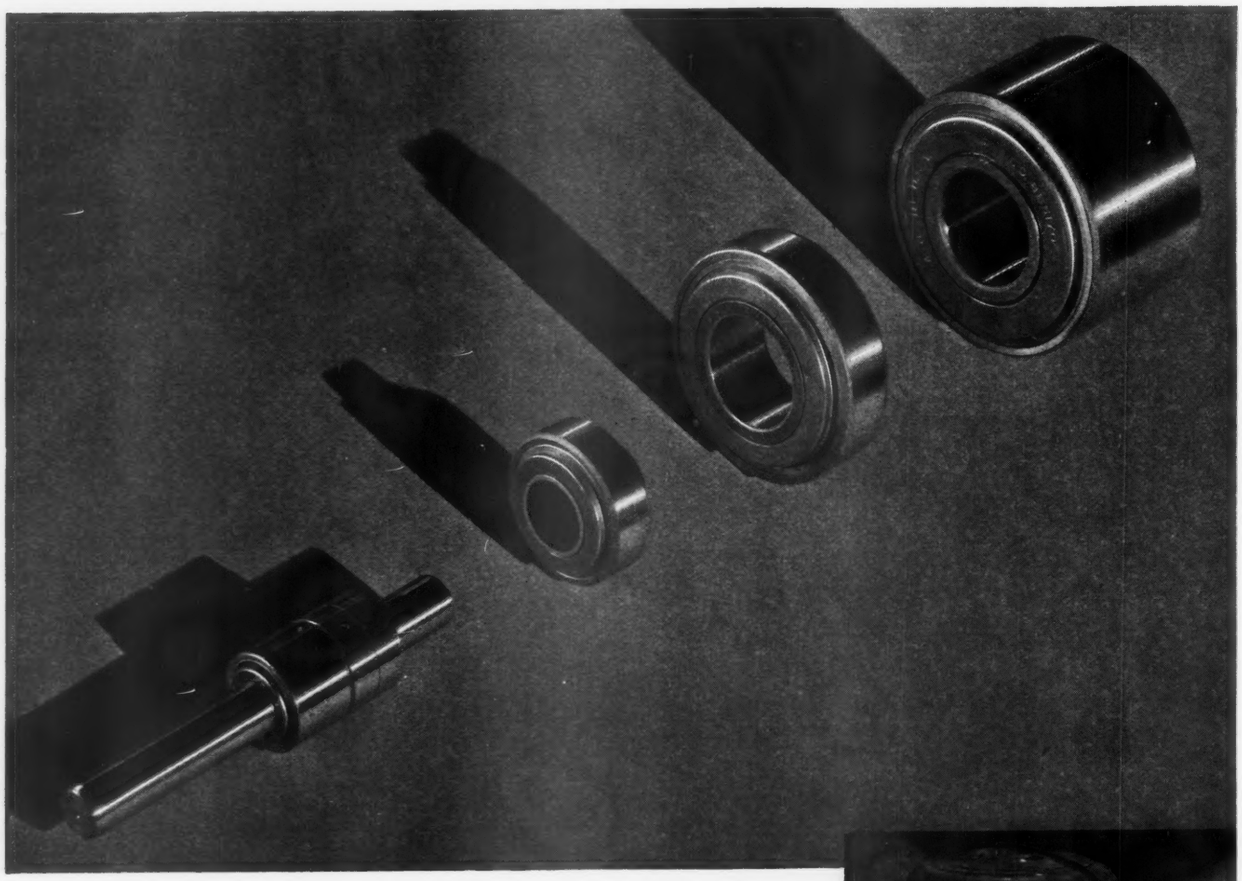

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Factory
Management and Maintenance
L. C. MORROW • EDITOR

Labor Is Tipping the Apple Cart

SOMETHING is wrong in the labor picture. As this is written, the Committee for Industrial Organization and General Motors are deadlocked. Just as recovery is well under way the one industry that did more than any other to shake off depression is stymied. Moreover, the automotive industry occupies such a strategic position in our economy that through it all industry is being attacked.

Wages in the automotive industry are high. Hours are satisfactory to employees. Great progress has been made toward year-round employment. So if we look back of the scenes we find that the objective of the C.I.O. is the closed shop. Peering closely, we see the check-off as an additional, though future, objective of major importance.

The history of industry in America indicates that only a minority of employees wants to belong to a union; obviously the majority does not want the closed shop. If a union cannot get its members to pay dues without the check-off, it is evident that the check-off is unsound. Further, there is statistical evidence that the average annual income per employee in the major unionized manufacturing industries is less than that in the major non-unionized manufacturing industries — which means that the closed shop itself is unsound.

So we can conclude only that the C.I.O. attempt is being made with the hope that the anti-employer sentiment aroused during the past several years plus the distinctly pro-union National Labor Law will so influence public opinion as to make the attempt successful.

THE NATIONAL LABOR LAW is the principal thing that is wrong with the labor picture. The country will be better off if we scrap this law and start all over. If we must have a law, let's have one that makes unions as well as employers responsible under it. In that way we can make for prosperity. Labor unions have an economic reason for existence. They have nothing to fear from a law that will allow them to fulfill their economic mission, while at the same time they are held responsible for their actions.

A. F. WAKEFIELD
President
The F. W. Wakefield Brass Company
Vermilion, Ohio

We're "Small Plant" and Like It

"What if we are little?" is this small-plant executive's retort to those who wonder how he can hope to compete with the big fellows. "To us it looks as if the small factory has as good a chance as any." To us it is clear that successful operation in this instance depends largely upon knowing how to take advantage of the equipment and research of bigger plants

FRIENDLY souls, on first becoming acquainted with our business, are likely to worry about us. Here we are, in an industry containing several of the largest industrial corporations on earth, and in full competition with these giants. All told, we employ about 60 people in our factory. Our town has excellent railway service, but out plant does not even have a switchtrack. To the casual view of the man who believes in the invulnerability of big business, ours is indeed a sorry plight.

Ungraciously enough, we refuse to accept such generous sympathy. If we are in danger, we are not smart enough to recognize it. We think we are right where we want to be. In times when most people are able to earn a profit, we generally manage to get our fair share. Our employees have rather steadier employment than is perhaps general in our industry. As for the big companies, we buy many things from them; we sell many things to them; in part of our field we compete directly with them. We see no reason why, just because we are small operators, we should have an inferiority complex.

Some folks belong in large organizations. Others incline to like the independence of running their own small enterprises. Certainly there is room for both types. We happen to be small-plant men. We feel that we can employ our energies more productively in just the sort of business that we have. There must be thousands of others who have about the same outlook.

As Good a Chance as Any

What chance, after all, *has* the small manufacturing business in our American set-up? To us it looks as if it has as good a chance as any, if its management is on the job. The large industry has certain important advantages, such as the use of specialists, maintenance of comprehensive research facilities, big-quantity production, and purchasing with resultant savings. The small business has equally important advantages such as proportionately lower overhead, quicker "maneuverability," lack of hampering policies which in a larger business must be laid down to prevent serious errors by subordinates so far removed from genuine executive supervision that thou-shalt-not's are required.

At the same time, the small business can usually find ways to adopt for itself most of the advantageous results of the facilities of the big businesses. For example, consider a product that we have been given

credit for pioneering. This is a bowl type of electric lighting reflector constructed of a urea-formaldehyde plastic. Obviously a little outfit like ours could not do much plastics research. We should not be likely to command the services of a full-time designer in this field. Large plastic products require heavy equipment beyond the financial resources of a company such as ours. So what to do?

The particular plastic that we selected for this reflector is a product developed by a scale company to cut weight out of its product. The material fits our job precisely, and costs us materially less than if we had undertaken the research originally. The designing was done by a firm of leading industrial designers—just as good people as any of the big companies could hire.

But How Make It?

Now we come to the problem of the equipment for making this very large piece. The requirement is for a very large press, a very large set of molds, and an atmosphere so clean that the whiteness of the reflector will not be marred—and it takes only a tiny fleck of dirt to spoil the appearance of the finished product.

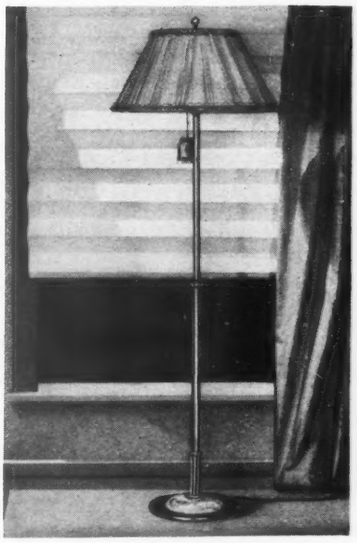
Where can we obtain such manufacturing facilities? Obviously not in our own little factory, which is hardly large enough to house the plastic press required. One of the large electrical companies—a direct competitor, if you please—has just such a press in just such an air-conditioned pressroom. It takes the contract, at a price that suits us and no doubt yields a fair profit. We pay for making the molds, the second largest set of plastic molds in the world. Thus, at a cost of comparatively few thousand dollars, we are turning out our plastic reflector on a press exerting 1,500,000 pounds of pressure.

There is a tabloid tale to illustrate how a small manufacturer can get along without elaborate organization and heavy investment in equipment. To be sure, it would be a sad plight for industry if all research were suspended on this same principle, or if all extra-expensive equipment went unpurchased. At the same time, the existence of small concerns like ourselves, ready to pay a fair price for the products of research and for the services of expensive equipment, no doubt furthers the decisions of large companies to make such outlays.

The use of plastics for lighting reflectors is one of three major steps which our one little company has pioneered in the lighting fixture industry. The other two are today taken so completely for granted that it seems almost ridiculous to think that they could ever have been innovations. Nevertheless, we were the first people in our industry to ship in corrugated board cartons, and the first to use die-casting in place of heavy brass castings.

Why has it been possible for us to come out ahead of the field in these respects at different times? Simply because when we want to make a decision, we make it. It does not have to go through a lot of committees or be discussed with a succession of superior officers over a period of months. If someone were to come to us today with, say, a new and better type of switch for use on a lamp, the decision could be made immediately. If any of my brothers happened to be at hand, I should probably ask them in to have the switch demonstrated and to see if they could find any weaknesses that had not occurred to me. If it turned out to be obviously sound in design, better, cheaper, in any way more desirable, I should probably give out the order then and there. Along about next Monday, when the first shipment arrived, our lamps would go out to the customer carrying the newer and better variety of switch.

A press that exerts 1,500,000 pounds of pressure. An air-conditioned department where not even the tiniest fleck of dust can spoil the appearance of the product. Those are two requirements for manufacture of this lighting reflector. What small plant could hope to possess such big-plant production facilities? What this small concern did, illustrates how a small manufacturer can get along without elaborate organization and heavy investment in equipment



Nobody ever told this small-plant executive that a pedestal lamp had to have a length of gas pipe inside it. So in his ignorance he made the thing of tubing, put the conventional iron casting inside the base, riveted the tube to the base. Center of gravity is lower, total weight less, wireway more generous. Also, the tubing is made in two lengths for convenience in shipping. Result, a lamp that could be put on the market for 60 cents less than anybody else could sell a similar lamp for

In this there is no implied criticism of big-plant procedure. The bigger the organization, the more complexity is inherent in good management. It is this fact alone that saves us small fry from being swallowed up or driven out of business by the big industrial units. They can do many things more economically than we can, but every time they add another ten million dollars of volume, their overhead expense goes up. Ours stays right on bedrock all the time, because we know that if ever it starts climbing we are out of business.

No Experts Needed

There are some real advantages occasionally in our lack of experts. No doubt you are familiar with what are known as I.E.S. lamps—the floor lamps, bridge lamps, and table lamps developed within the past few years to supply home lighting that is really good for seeing. These lamps are distinguished from older kinds by the translucent bowl that surrounds the light source, thus diffusing the light that comes through the bowl and also deflecting a sufficient amount of light to the ceiling for general room illumination.

We had never made any of these lamps, but decided last year to go

after some of this business. So we designed a limited line to meet the I.E.S. specifications. When we put it on the market at a price that would yield us a fair profit, a general lamentation went up. We were told that our lamp would not work. Why? Well, nobody ever seemed to have made a floor lamp or any other kind of high pedestal lamp without running a length of gas pipe up the inside of the thing, and then assembling the parts over the pipe, binding them all on by a nut on the bottom of the pipe.

Where Ignorance Is Bliss

In our ignorance, we left out the gas pipe. We made the thing of tubing, put the conventional iron casting inside the base to prevent tipping, then riveted the tube to the base, beading it to provide a shoulder. The lamp seemed firmer and better engineered. Its center of gravity was lower, its total weight less, the wireway more generous. Furthermore, we discovered that we could make the tubing in two lengths so that for shipping it could be broken at the middle, then joined by a simple set-screw joint which could be covered by a brass ring of decorative value.

The savings in manufacturing cost from leaving out the gas pipe, plus the savings in shipping weight due to this omission, plus the saving in shipping cost that came because we could pack our floor lamp in half the length of container, let us put this lamp on the market at a price some 60 cents below what anybody else could afford to sell a similar lamp for.

All told, then, our lack of experience in conventional lamp design gave us a product that seems to be better in its service to the user, is cheaper in price, and otherwise easier to sell. If we were a twenty-million dollar corporation, I'll bet it would have taken us three years to get that radically different design authorized.

Any small manufacturer has this sort of advantage ready to hand, if only he will take and use it. If the small manufacturer attempts to compete with the big fellow on the big fellow's own terms, he is out of luck. But if he finds a competitive basis that suits him and his peculiar abilities, he can do very nicely indeed.

Our basic philosophy is to produce an assortment of simplified lines, selecting only those items that we believe can be sold in large volume. Because we are small, and expect to remain small, we feel no obligation upon ourselves to try to get all the business there is. Instead, we try to get the business that fits into our plant and into our manufacturing experience. On this basis, we can make money and provide rather steady employment for our regular people.

By no means all of our business is in the class of consumers' specialties like I.E.S. lamps. Any visitor to our plant inquires about dozens of simple little pieces, largely stampings of brass and bronze, which do not seem to fit into any of our finished products. The answer is, they do *not* fit in. They are parts made for other manufacturers, chiefly for the large manufacturers in the electrical industry. We get the contracts because we can beat their own manufacturing divisions on price or quality or both.

They Always Renew

One little brass sleeve has been a mainstay of our press department for seven years now. It is made for one of the big companies, and we make a good many hundred thousands per year. During the period of our contracts on this part, the big company's division has had several managers. One of the first things each one undertakes is to stop this business of buying a part from us while they have ample factory space and equipment standing idle. They summon me in to talk it over. Each time I offer all our facilities and experience to help them make the part if that is what they wish to do — they are good customers for many other of our products. Each time they set their engineers and cost accountants to figuring the prospective savings they will bring about by taking this piece back home. Each time, so far, our contract has been renewed.

Sometimes the big plant serves the small plant, as in the making of the reflector cited by the author. Again, it may be the small plant that serves. For instance, this one keeps right on selling a brass sleeve in large quantities to a giant competitor, despite the fact that the latter has idle equipment suitable for the job

No Supervision, No Inspection

The reason is only slightly one of technique. This is a drawn shell, and we immodestly admit that we are among the world's most skillful in the drawing of small pieces. But they could make it just as well, once we showed them how — and we would cheerfully show them all we know. No, we get that contract because we can take it profitably with an overhead loading so slight that it would hardly cover the big company's factory overhead as far as the plant manager. The man out in our plant who makes the sleeves knows how so well that he requires no supervision and no inspection. If he makes a defective one, he throws it out as quickly as I would. About all the executive attention that this part originates is the periodic trip to explain to a new management why they ought to keep right on letting us manufacture it.

It does not seem to us then, that things are hopeless for the small manufacturer. We see definite limitations in what we can hope to do at a profit—but so do we see similar limitations on the big manufacturer, for reasons inherent in his size. The fact is, there exists in this country of ours a place for the little fellow as well as the big. Some things that the big fellow cannot do profitably, the little plant can handle at a nice profit. Many things that the small plant has neither facilities nor finances for, the big plant serves up to the public in top-notch style. In between, there is a sizable volume of business which belongs to whomever it is earned by, and it is always a question which size of establishment can do it best at any given time.

No Thirty-Hour Week, But—

Congress will try to regulate hours and wages. How? No one knows. Here are possibilities

CARTER FIELD
Washington Correspondent

LEGISLATION regulating wages and hours in industry — aimed at accomplishing the objectives of NRA — is virtually a certainty in the present session of Congress. But what form it will take is by no means certain. There were at least four possibilities. Now there are only three.

The 30-hour week is no longer a possibility. There was the chance, though never a strong one, of a constitutional amendment giving the federal government the right to regulate hours and wages. In his address to Congress the President showed conclusively that this route would not be followed.

Three Possibilities

Here are the three plans now under consideration. Bear in mind that the President himself, as this is written, has *not made up his mind* as to which offers the surest route to the objectives, and that Supreme Court decisions may play a part.

1. *O'Mahoney Bill.* This measure aims at accomplishing all the NRA ideals, including child labor regulation as well as minimum wages and maximum hours, by the simple expedient of forcing every corporation doing interstate business to take a federal charter. The idea amounts to licensing.

2. *Guffey-Ellenbogen Plan.* Under this plan Congress would enact a code for each industry, thus applying NRA piecemeal. This eliminates the hazard of "delegating power," so important to the Supreme Court in the "hot oil" and other cases. There would be no such delegation of power, for example, as when Congress permitted Gen. Hugh Johnson to approve codes, or the President to impose codes. Congress itself would write the codes.

3. *Richberg Plan.* This would attack the same problem by what might be termed the Federal Trade Commission or Clayton Act route. It is based on the idea that the Supreme Court has upheld the federal government's power to prevent unfair competition in all sorts of cases. Obviously, Mr. Richberg points out, if one employer pays a lower rate of wages than his competitor, or works his employees longer hours, or employs child labor, he is taking an unfair advantage.

President Roosevelt has not changed his mind about the 30-hour bill. Chances of anything of the sort are practically nil. Incidentally, all the hubbub about organized labor's being so strong for this measure can be taken with a grain of salt. Union labor leaders always like to have something to trade with.

Best opinion is that the Supreme Court will uphold the Robinson-Patman Act. This judgment is based largely on the court's unanimous decisions upholding the Illinois and California fair-trade statutes.

No Planned Program

It is now clear to disappointed business men — and to reformers as well — that there are to be no clear agenda, laid down in advance, for the present Congress. The program will develop as it goes along, guided somewhat in its building by changes made through expediency by the gentleman in the driver's seat, and molded importantly by forthcoming Supreme Court decisions. There will occasionally be indications that the President is letting Congress solve its own problems. But do not be unduly deceived.

It may be stated with the utmost positiveness that there will be no substantial modification of either the tax or social security legislation. There will be minor amendments to both acts — for instance, a probable amendment to the tax law that will help corporations deeply in debt. Another may liberalize present allowances for replacing obsolete machinery and equipment. There *will not* be any modification of the underlying principle of taxing undistributed earnings. There will *not* be any liberalization of the rulings governing new or additional plant or productive capacity.

The reason why is simple. The underlying principle here is part of the warp and woof of the Roosevelt economic doctrine. It is *not* a new doctrine so far as he is concerned. It is not something to which he has been converted by the Brain Trusters since entering the White House. It is far from being just a bright idea about taxing the rich by forcing out dividends that would put them in higher income tax brackets. And it goes away beyond even the idea of protecting the minority stockholders from the ambitions of their company managers.

"Planned Economy"

It is much more fundamental. It goes to the idea of "planned economy." It revolves around an underlying idea of Mr. Roosevelt's which every business man should remember, that the big business executives of the country failed rather lamentably in 1929, and that direction of some of their activities by presumably disinterested government officials might be a real blessing.

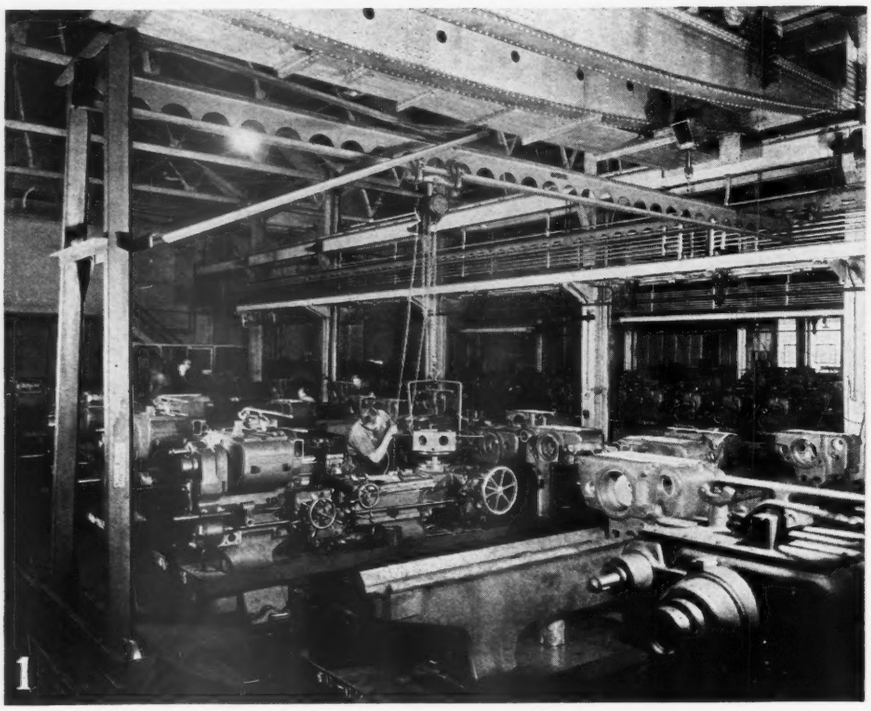
Whether one agrees with this logic — whether one can shoot it full of holes — is academic for the time being. That is the theory of the men whose judgment Congress will follow during this session.

As to the Social Security Act, everyone concerned admits the necessity of amendments. What they will be is still undecided.

Most labor leaders, including William Green, want to stop payroll deductions. Their idea to date is to shift this burden entirely to the employers. At the moment this would seem to be the probability. A small group of labor leaders would like to eliminate the payroll taxes altogether.

But most of the men close to the President seem to think that the idea of each worker's knowing that *he* is contributing something to *his own* social security, that a percentage of *his own* earnings is being laid aside for this purpose, and has an effect on what he will draw in time of need, is vitally important.

Here Is Simple Effective Handling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THE BIG overhead crane isn't hurt by having plenty of work to do. Man hours may be wasted, however, if it gets tied up.

On its turret lathe assembly floor, therefore, The Warner & Swasey Company, Cleveland, uses an auxiliary handling system. A one-leg crane, running on one floor rail and one overhead rail (Figure 1) serves for the lighter lifts. The leg is set away from the building columns to allow clearance for the cab of the big crane. Both cranes can function simultaneously.

Part of a System

This arrangement is only part of a coordinated handling system. Monorails are used over machines, power and hand trucks for materials and parts transportation. Illustrated in Figure 2 is an electric hoist mounted on a jib crane, which serves a part of the heat-treating department. Figure 3 shows a chain block and post crane used in the same department.

There is nothing elaborate in the entire set-up. It happens to be the kind of arrangement the average plant engaged in making products of considerable variety in lots that are not too big can use.

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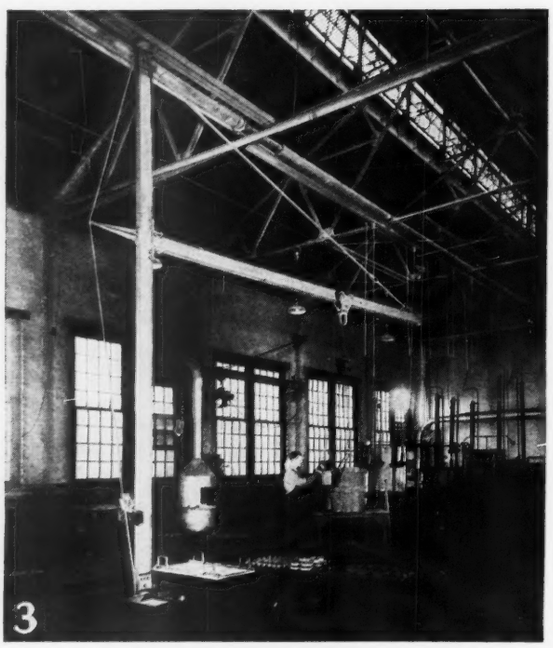
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Running Our Second Motion-Study School

An advanced course this time, reports Mr. Punton whose first school was described in Factory for December, 1935. Here are the methods used, some of the results obtained, much of the basic thinking that led this concern to continue its motion-study program

C. W. PUNTON
Factory Superintendent
Mine Safety Appliances Company, Fittsburgh

EARLY in 1935 we became interested in the possibilities of improving plant operations and reducing operator fatigue through modern methods engineering. As a first step, we organized a training course for principal supervisors under the direction of the Methods Engineering Council of Pittsburgh, during which the fundamentals of job analysis, time study, motion study, and incentives were studied.

This was an important and necessary step for the more intensive work that was to follow. We also realized that it is one thing to be able to recognize the possibilities for improving an operation and quite another actually to work out the better method, set it up, and make it work successfully. Whenever methods changes are undertaken, obstacles are encountered. There is also a tendency for the operators and supervisors to resist change. It was therefore deemed necessary to give our supervisors further instruction and particularly experience in making actual studies.

So an Advanced Course

Accordingly, an advanced training program was set up, again with the assistance of the Methods Engineering Council, and methods work was resumed in the fall of 1935. The general aim was to teach methods improvement by actually improving selected jobs. We wanted to bring home to the supervisor that methods engineering is not abstract but something he himself can apply to his own work.

In order to make detailed job study and discussion practical, the original training group was divided into several sub-groups. To each sub-group was assigned a specific product, process, or operation for study. The size of each sub-group was limited to ten members. A permanent committee composed of the works manager, the chief engineer, the general foreman, the tool supervisor, and the plant methods engineer formed the nucleus of each sub-group. These men were interested in every job studied and hence attended all group meetings. The other members consisted of the foreman in charge of the particular job the group was to study, his assistant or assistants, and one member from a staff department who desired to increase his general knowledge of methods engineering procedure.

Studied Repetitive Jobs

To be suitable for group study, a fairly repetitive job was desirable so that when savings were made they would at least offset the cost of making them. Since group meetings were held only twice a week and were expected to extend over a period of several months, the job had to be in work fairly constantly so that it would be frequently avail-

able for study. We preferred that the operations performed on the part or process should be short and simple so that they could be readily visualized and understood by all members of the group. We felt that it would be advantageous to have sample parts at the meetings, which could be seen, handled, and perhaps experimented upon.

No Two Studies Alike

The factors that received the most concentrated study varied with the characteristics of the job. On a punch press job, design of tools and handling of material between operations received the chief attention. On a small first-aid item, neither of these factors was particularly important. Although they were not overlooked, more thought was given to processing operations, improvement of quality, and the detailed methods of performing the various hand motions required. On a study of the manufacture of self-servicing charging racks for Edison Mine Lamp batteries, departmental layout had to be studied first before detailed methods could be improved. On sewing machine operations, fixture design, safety, and quality were chiefly emphasized.

At the first meeting of a given sub-group the general plan to be followed during the study was determined. The past year's activity and the estimated future activity of the job were ascertained. From these figures and from the time allowances already established on the work, the yearly labor cost per 0.0001 hour was computed. This provided a quick way of determining how practical it was to consider any suggestion for improvement in detail.

For example, on one job the yearly labor cost was $30 per 0.0001 hour of labor. On one of the operations of the job, a time allowance of 0.0024 hour was established. This operation therefore cost $720 per year in direct labor. When the operation was studied it was seen that it could be made "two-handed" with an expenditure of about $25 for a fixture. The estimated saving was 0.0010 hour, which would amount to $300 per year. It was obviously desirable to make this improvement.

A further improvement on this same operation was also suggested. By providing some semi-automatic equipment, the time could be reduced to 0.0004 hour per part, a further saving of 0.0010 hour or $300 per year. The necessary equipment, however, was roughly estimated to cost $1,500. Thus it was seen at once that the second suggestion was not practicable on the basis of present production.

Homework for All

After a preliminary discussion of how the job should be studied, various members of the group were asked to prepare certain material for the next meeting. One made a templet layout; another drew up a process chart of the type that seemed best suited to the job; another pre-

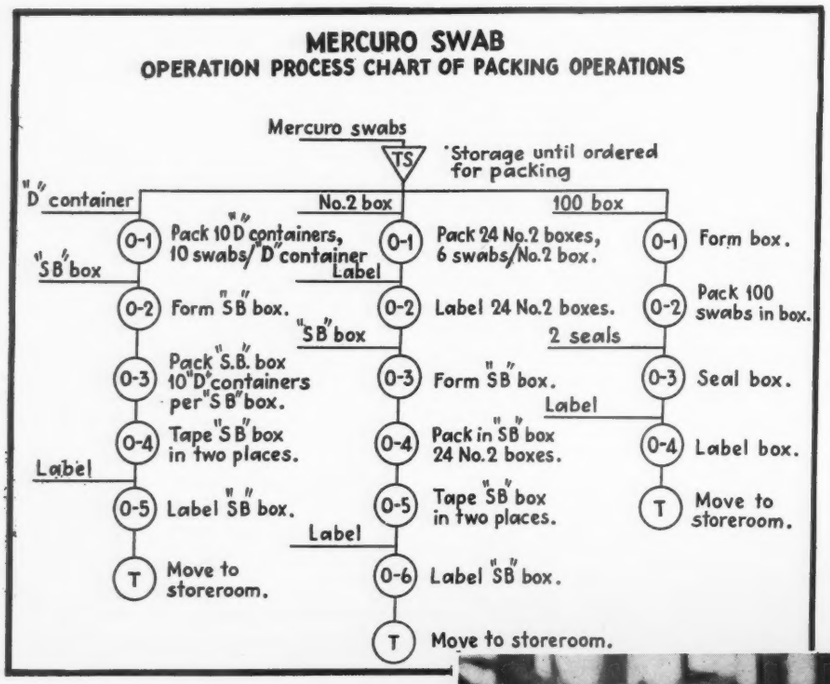


FIGURE 1. Process chart of packing operations prepared to assist group methods study of one of the company's first-aid products

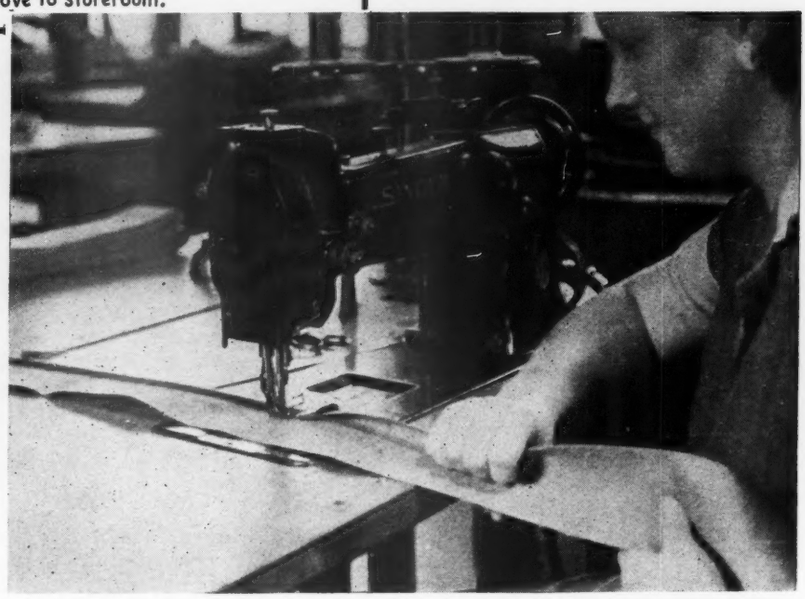


FIGURE 2. (Right) Old way of sewing 1-in. hem in leatherette protective hat lining. Operator had to guide lining throughout sewing. Lining was allowed to fall on floor; as a result got soiled and creased. A second operation was necessary to pick up sewed linings

FIGURE 3. (Opposite page) New method of sewing 1-in. hem in leatherette protective hat lining. Improved fixture relieves operator of guiding lining after strip is started. Lining is wound on reel to keep it from getting soiled or creased. Operator utilizes running time to load and unload reels. Quality was improved, operation made less fatiguing, production increased 51 per cent

pared samples; another took motion pictures.

At the second meeting, this material was presented. Process charts were reviewed. The present layout was examined. Film loops of operations were projected continuously as the group sat and watched. Almost immediately suggestions for improvement began to flow from the group members. The chief engineer saw possibilities for design change; the tool supervisor suggested a new tool; the foreman pointed out an unnecessary motion.

Each suggestion was carefully considered and either acted upon or dropped. If experiment was necessary to determine the feasibility of an idea, a member of the group was assigned to do the necessary work and report the results at the next meeting. Many of the suggestions involved departments not represented at the meeting. When this occurred, the departmental heads were invited to sit down with the group for a few minutes to consider the particular point that affected their activity. Sales, production, inspection, stores ledger, accounting, and purchasing departments were all consulted from time to time.

Operators Must Share

Each suggested change was carefully considered from a quality and safety standpoint. The new method must improve quality; at least it must not affect it adversely. It had to be a safe method to warrant further consideration.

In addition, the new method had to be more desirable from the operator's viewpoint, because one of the objectives of the study was to have him share in the improvement. Fatigue was studied carefully. Methods that were easier and less tiring were sought. During the development of the job, care was taken to make sure that experiments and changes did not interfere in any way with the operator's earnings.

Detailed estimates of cost and savings were prepared. If a small tool or fixture costing under $100 could pay for itself in savings within one year, it was ordered. Machines that could be used on other jobs were purchased if the job under study would pay for them within five years. In general, it was the policy to adopt every suggestion that was in any way justified as an encouragement to further suggestions later on.

Why a Consultant?

It may be wondered why, after an intensive course in methods engineering, it was considered desirable to organize an advanced course under the direction of a consulting firm rather than to handle the program ourselves. In the first place we realized that, although we were fairly well grounded in principles, we had had only a limited amount of practical experience in applying them to actual production problems.

More important, however, we realized that unless we had a formally organized program there was the chance that it might not be carried forward steadily. All members of the group were busy men well loaded with duties and responsibilities, and there was the danger that methods work might be slighted in the press of everyday productive activities.

Probably the greatest benefit of all was the continued, persistent effort towards improvement that was inspired by experienced leadership. We found all too often that for various reasons a change would not work the first time it was tried, and there was a tendency upon the part of some of the group members to want to drop the suggestion at once. Again, when a minor improvement was made there was a tendency to consider the job done rather than to regard it merely as a step in the right direction. Finally, there was always the feeling to be overcome at the beginning of a project that the job had been studied before, was being efficiently done, and probably could not be materially improved. The steady encouragement to go farther and the reasoned optimism as to ultimate results that experienced leadership provided, were major contributions to the success of the program.

On the jobs that were studied, savings well in excess of the estimated 20 per cent were obtained. The operations were made easier for the operators; when time allowances were established on the new methods, greater earnings for less expenditure of effort were possible.

Educational Value

Of more fundamental importance than this, however, was the educational value of the work. By actually applying methods engineering principles to their own work, our supervisors demonstrated to their own satisfaction that these principles were not theoretical and useful only for classroom discussion, but were practical everyday aids in improving operations and reducing waste and fatigue.

As a result they have begun more and more to undertake methods changes upon their own initiative. In some departments, set-ups have been worked out that would do credit to an experienced methods engineer. Throughout the plant there is a willingness to experiment with improved methods that is more than a matter of temporary enthusiasm.

We still have much to accomplish. Indeed, because we keep improving our "best methods" almost as fast as we devise them, we may never reach the point where we are satisfied that we have done all it is practical to do. There are, however, an increasing number of well-worked-out methods appearing in the plant, and we therefore feel that our methods work thus far has been productive of excellent results.

A Take-Away That's 99% Automatic

Outside of two hours a week that one man takes to load flash into gondolas, this trolley-conveyor collecting system is completely automatic. Almost equally important, it's up out of the way

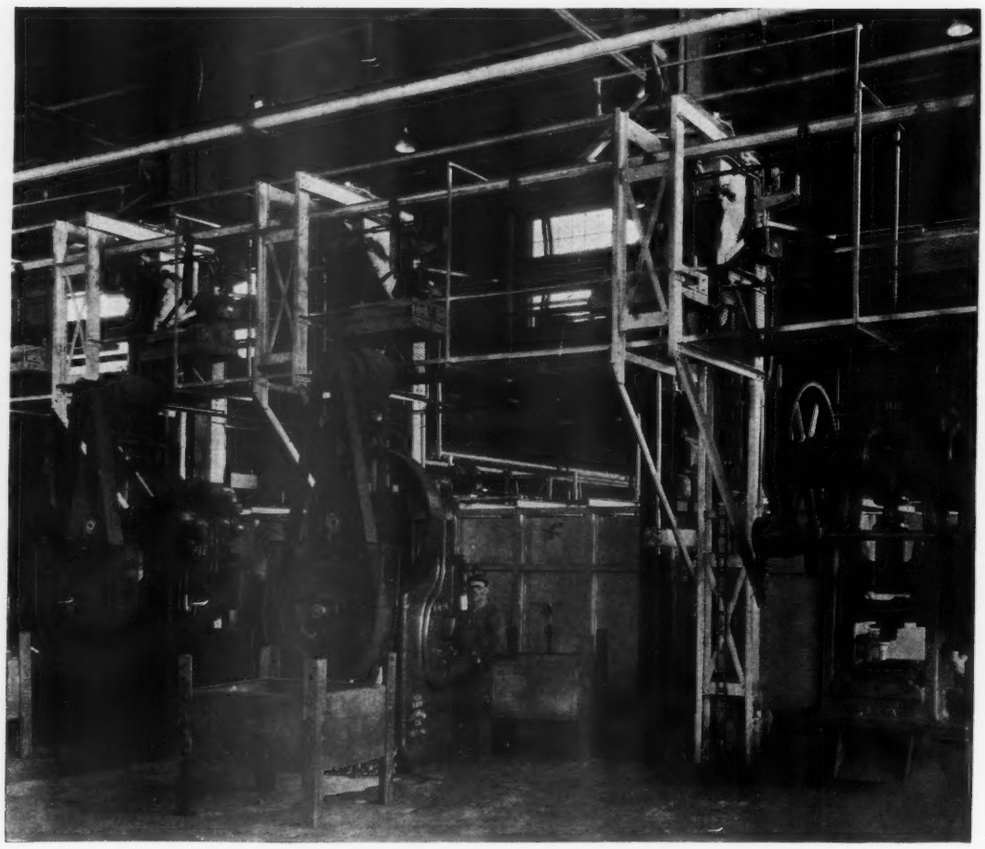
ARTHUR VAN VLISSINGEN, JR.
Consulting Editor

From the Experience of Muncie Plant of
Chevrolet Motor Company

COLLECTING and disposing of flash from drop forgings is never easy. The material comes in awkward shapes and sizes. There is the problem of keeping separate the various kinds of steels for most advantageous disposition. Usually it involves an awkward amount of trucking and manual handling, with resultant high costs and a general cluttering up of the forge shop.

When we came to laying out this forge plant, we urgently desired a workable, economical way to handle and dispose of our various kinds of flash separately. Obviously it was a job for a conveyor. But what kind of conveyor? We had some ideas, and the equipment manufacturer's engineers contributed their share. The result is an installation which, so far as we know, does the job more economically and more satisfactorily than any method that has yet been devised.

We forge three different kinds of steel — chrome, nickel, and low carbon. Moreover, a given hammer with its trim press may be operating on one steel today, on another tomorrow. This precluded setting up a rigid method of handling the flash. Our method simply had to be flexible to take this diversification into account and permit separate



From skip bucket to hopper, from hopper to trolley bucket, from trolley bucket to storage bin. Three dumps and it's out. Automatically. There's a skip elevator at each trim press. As soon as the skip bucket is loaded, the operator presses a button and away she goes to discharge into a hopper. The hopper discharges when the right trolley bucket comes along. And the trolley bucket discharges in turn when it comes to the right compartment of the outside storage bin. The idea is to move flash without manual handling and at the same time keep separate the various kinds of steel that are being used

handling, storing, and shipping of the three types of steel flash.

The backbone of our equipment is a Jeffrey trolley-conveyor collecting system, loaded by skips and delivering into a three-compartment bin for storage preliminary to dumping into railroad cars. Our first idea was to have the trolley conveyor come down alongside each trim press, but this idea had to be modified because the installation would have taken up far too much floor space in accommodating the dips of the conveyor. We had to find a technique that would permit us to keep the conveyor well overhead and out of the way, and get elevation by some other device.

Flash in a Bucket

Skip hoists are the answer. They are of single-bucket, single-strand elevator type. Each bucket carries 40 pounds of flash. One skip is located at each of 14 presses. When the press operator holds the forging in the press, the trimmed forging discharges into a tote box, and he still holds the flash with his tongs. If the flash is long and of the type likely to clog a subsequent gravity flow, the operator cuts it in two with a power chisel. If the flash is of convenient size, he immediately places it in the bucket.

When the bucket is filled, the press operator pushes a control button right on his press. This makes the skip bucket rise and discharge its load into a receiving hopper at the top of its run. Then it automatically returns to its original position at floor level. The circuit takes 16 seconds, which is less than the interval between press operations, so that there is no delay to the operator. All he does is press the button when the bucket needs emptying, and then he goes about his work. If the receiving hopper is already filled, a safety device assures that the bucket will not rise until the hopper is cleared.

Because of the intimate connection between receiving hoppers and trolley conveyor, this is the best time to describe the latter. This conveyor, which is 18 feet above floor level, is provided with rectangular buckets about two and one-half times the capacity of the skip bucket. The buckets look alike, but are differentiated by the position of tripping levers. There are three positions corresponding to the three compartments in the flash bin at the end of the system.

There are 60 buckets on this conveyor, with the right number for each steel corresponding to the proportionate production of flash. These buckets have flat-hinged latches, and the tripping levers are so arranged that any one bucket will always dump into the same storage bin compartment. Should it be desirable to run more than the average number of hammers on one type of steel, buckets not regularly used for this steel may be used for it by adjusting the trips over the bin.

To insure loading any given bucket with the right type of steel, each is equipped with a lug that trips an overhead hopper — or does not trip it — according as the hopper is set. The operator below can change the vertical position of the switch on the side of the hopper to any of three positions corresponding to the position of the operating lugs on the three sets of conveyor buckets. Thus, when he shifts from one kind of steel to another, he makes this adjustment and is thereafter assured that the flash will be dumped from the hopper into the proper conveyor buckets.

The hoppers are all provided with discharge lips which also act as valves. The lip stands upright to retain the load in the hopper, and is held by a latch. An electric solenoid trips the latch and permits the lip to fall, thus acting as a chute from the hopper and discharging the hopper contents into the trolley conveyor bucket. The lip remains down after the conveyor bucket passes. When the skip bucket rises from below, a lug on the skip chain resets the lip. If the lip is not down, this means that the hopper contains a load, and the skip bucket is automatically prevented from rising until the hopper has been dumped and the lip is down.

Everything under Control

Operation of the solenoid is accomplished by a lug on the conveyor bucket contacting a limit switch, as already described. It is the vertical position of the limit switch on the side of the hopper that operates the trip solenoid, and it is this vertical position that can be changed by the operator from below, as already explained.

The conveyor buckets are suspended by springs when empty; a load pulls the bucket down about an inch and carries its weight on a solid steel frame. The reason for this is easily understood. Suppose the empty conveyor bucket for use with high-carbon steel reaches a hopper containing high-carbon steel. It trips this hopper and receives the hopper's load. But if the conveyor bucket is already loaded, it is riding just enough lower than the empty position — and in this lower position it misses the limit switch as it goes by.

At the end of the line . . . a three-compartment storage bin waiting for flash from the trim presses. The conveyor has to deliver the right kind of flash to the right storage compartment

When the loaded bucket continues on the conveyor, it eventually reaches the outside bin with hopper chutes that can be opened above the switch track. Here the bucket dumps into the bin indicated by its tripping lever, and continues around empty until it once more reaches the forge shop for another load.

Each bin in the storage hopper will hold just enough steel flash to load a 40-ton gondola car. One man has the responsibility for loading these cars when there is enough flash of one type of steel. He dumps one-third of a carload at a time, moving the car with a car-mover. The entire job takes him not more than three-quarters of an hour, perhaps less if the flash flows freely and does not have to be poked loose in the chute. With about three cars a week to load, it is seen that he spends about two hours a week in loading flash into freight cars.

This one operation is the only thing about the whole matter of flash handling, disposal, storage, and loading that requires any working time. In every other respect it is 100 per cent automatic. It keeps our forge shop so free of flash scrap that one sweeper maintains the floor in condition to suit the most exacting plant housekeeper.

Replace the unattractive dusters and smocks with becoming cotton uniforms

Women Take Appearances Seriously

DONALD A. LAIRD*
Rivercrest Laboratory
Hamilton, N. Y.

She thinks it is her right to take time out at any moment to powder her nose

BECOMINGNESS of the colors of garments is a prime consideration with women. This is as significant for the factory or office manager as it is for the salesman of wearing apparel.

A serious error is made in many plants by requiring women workers to wear an unattractive duster or smock. It is not an error to insist upon clothes that will provide safety and comfort, but it is an error to have clothes that are unattractive to the eye. Young girls just entering industry prefer office to factory work largely because they can "look better" in the office.

Throw out the "linen dusters" and khaki smocks, and replace them with attractive cotton uniforms!

They Judge with Their Eyes

For women do take appearance seriously. They judge things by their eyes, whether the merchandise they buy or the merits of their jobs.

They want attractive, tidy work places. They want to be attractive both at work and away from work.

But appearance is more than a simple matter of clothes. Appearance plays one of the leading roles in the woman worker's life. She works more enthusiastically for the firm that has better office furniture, provides attractively decorated restrooms, makes a beautiful product. For the work surroundings and the product become mentally identified as a part of the worker. If these things in her working environment are displeasing to her eye, the feeling grows that she, too, is displeasing to the eye. And her eye is more critical than a mere man's.

Stretching her weekly pay to provide clothing that will keep her at the top in attractiveness is an all-consuming problem with many working girls. Some half-starve themselves for dresses and silk hosiery. Some firms have found it a good investment in the self-respect and morality of their women operators to have a separate room with facilities for making clothing after hours, and with a skilled woman in charge who can teach the girls how to make clothes and select clothes in good taste.

She wants a tidy place in which to work and—in case she does not eat outside—an attractive place to spread her lunch.

Her Inalienable Right

As a typist, she turns out a neater letter than a man typist. Again, appearance is a tell-tale feminine mark. And, at any type of work, she thinks it is her right to take time out at any moment to powder her nose, adjust her hair, clean a fresh spot from her dress.

Well, why not? Appearance, both personally and in the work she turns out, ranks high—probably because she feels inwardly, and without voicing the thought, that she does not have half the appearance men are already crediting her with.

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(This is the first of several articles by Dr. Laird on "Things Worth Knowing if You Employ Women." The second will appear in an early issue.—ED.)

*Author of "Psychology of Selecting Men," McGraw-Hill Book Company.

Measured Day Work

What... Why... How... A timely discussion of this incentive plan's philosophy, limitations, and values

R. H. ROSITZKE
R. H. Rositzke & Associates
New York

UPHEAVALS and readjustments accompanying our emergence from depression have resulted in very serious questioning of wage-payment plans. What type shall be used? How shall it be established? How administered? What will be the reaction of employees?

Such questions have their roots in a number of major industrial trends, which may be enumerated briefly as follows:

1. Increases in labor costs;
2. Attendant necessity for improvement of operating methods as a sound means of cost reduction — increased hourly rates, reduced working hours, greater productivity per hour;
3. Strengthened position of labor;
4. Basic improvements in the intelligence, working conditions, and standard of living of workers;
5. Fundamental scarcity of skilled workers;
6. Improved general business condition.

It seems to me that one of the soundest approaches to the wage problems brought about by these six factors is the incentive plan known as *measured day work* — provided, of course, that it is properly understood and applied.

What Is Measured Day Work?

The majority of incentive plans rate employees only in accordance with their productivity — output per unit of time. However, the worth of an employee is very seldom contingent upon only one factor. *Measured day work provides a balanced plan of rating a worker's value by considering four factors. It fixes hourly wage rates by setting uniform base rates by jobs and giving added inducements determined separately for each employee on the basis of his productivity, quality service, dependability, and versatility — measured over a relatively long period.*

Uniform Rates by Occupations

Applying measured day work thus resolves itself into two operations: First, the setting of a basic hourly rate for every occupation (tool- and diemakers, for example, might be divided into six grades), and second, the determination of an inducement to be added to every employee's hourly income.

Job evaluation, i.e., determining the hourly base rate for each occupation, can be done on a quantitative basis by evaluating the main characteristics and requirements of each operation. A number of workable plans can be found for a given plant in a given industry. As a rule, the main points to be considered in evaluating a job are:

1. Mentality necessary;
2. Skill required;
3. Responsibility involved;
4. Mental application required;
5. Physical application required;
6. Working conditions.

These points must be weighted for each occupation. The accompanying table shows how three of the largest plants in the country evaluate their most highly skilled jobs. The percentages clearly indicate the weight placed on each of the six job-evaluation factors. It will be noted that each company has assigned a certain number of "basic points" to the job. This is an arbitrary choice, and usually has some relation to the minimum hourly rate paid in the plant for the most unskilled work.

Starting with the basic points, the other points are set in accordance with the six factors enumerated above — mentality, skill, and the like — and ratings added.

In job evaluation the hourly rates are subject to review at stated intervals in order to accommodate them to new techniques or developments. For example (taking an extreme case), striping automobile bodies used to be done by hand, requiring a high degree of skill. Today this is done semi-automatically, and job evaluation would indicate the degree of reduction that should be made.

A numerical system of arriving at a base hourly rate has definite advantages. It eliminates guesswork. It unearths many unthought-of discrepances. It forestalls a possible accusation of job or rate favorit-

MAXIMUM EVALUATION POINTS

FACTOR	Co. No. 1	Per Cent of Total	Co. No. 2	Per Cent of Total	Co. No. 3	Per Cent of Total
Basic points	400	33.3	820	33.4	102	33.4
Mentality necessary	100	8.3	310	12.6	110	35.8
Skill required	400	33.4	596	24.2		
Responsibility involved	100	8.3	82	3.3	40	13.0
Mental application required	50	4.2	37	1.5	27	8.7
Physical application required	50	4.2	37	1.5		
Working conditions	100	8.3	485	19.7	28	9.1
	1200	100.0	2460	100.0	307	100.0

ism. Finally, it provides management with factual material for discussion or bargaining, and reduces turnover on key jobs by improving rate relationships.

Incentive Inducements

In a system of measured day work, the actual production of employees is compared with the standard they should have produced. The standards differ from the ordinary incentive in that no incentive allowances are included in the standard times. Where such control is practicable, weekly summations can be drawn up which include waste and quality records. In this way, productivity and quality service can be evaluated.

Regularity of attendance can be determined from absensteeism records, with due allowances made for lay-offs and other factors for which the management itself is responsible. Foremen and other supervisors can furnish additional information regarding the worker's dependability — such as his cooperative attitude or conduct. Records regarding his versatility — ability to learn, capacity for growth, diversified capabilities — should be incorporated in his personal history.

Stabilized Hourly Rate

The inducement, together with the base hourly rate arrived at by job evaluation, will make it possible to stabilize the hourly rate of every individual for a definite period of time. At the outset it may be advisable to review and change individual employees' hourly rates monthly. A period found practicable is the 3-month cycle, giving four re-rating periods a year.

The measured day work plan, therefore, enables a payroll department to close out weekly pay more quickly and accurately. However, it will not result in great payroll work savings because it is necessary to compute the ratings quarterly. On the other hand, such ratings can, if properly planned, be calculated during the "off work" periods in the department, thereby minimizing the peak load. Rate changes should be staggered to avoid concentrated effort and other complications.

What Are the Advantages?

Proponents of measured day work who have applied it successfully have demonstrated more accurate time standards after several years than they enjoyed under previous plans. The reasons for this lie largely in the disadvantages inherent in other plans. For example, time-study and rate engineers often hesitate to make methods changes involving rate changes because of employee resistance — the average employee considers the piecework rate as his personal property. Measured day work, with its fixed hourly rate over a long period, permits greater flexibility.

Measured day work wins the confidence of employees on long-cycle jobs on which it is difficult to estimate weekly pay under other incentive systems.

Under measured day work the supervisors must take the full responsibility for "fall downs." The plan therefore insists upon improved foremanship.

In addition, as mentioned before, the plan will also eliminate much controversy and administrative effort in dealing with allowances.

Questionnaire on Measured Day Work

Scope of Questionnaire Returns

Number of companies reporting	42
Number of factories represented	218
Number of hourly rated employees	196,552
Number of time study and methods men	594

Measured Day Work

Companies applying the plan	11
Companies that had considered the plan	18
Companies that had not considered the plan	21
Companies that had studied its application in industries other than automotive	11
Opinions that measured day work is an incentive	17
Opinions that measured day work is a driver	9

A Survey Questionnaire

A questionnaire regarding measured day work was sent out to a large number of outstanding industrials. Manufacturers were asked to state:

1. Whether they were using or had considered the plan;
2. Objections to measured day work;
3. Whether or not actual applications had been studied in industries other than the automotive;
4. Whether measured day work is an "incentive" or a "driver."

Companies responding employ more than 190,000 employees. It was interesting to note that those considering measured day work a "driver" had not studied its actual administration in companies other than those in the automotive industry. It has been a common belief that this particular idea applies only in that industry because of its conveyorization. Nevertheless, many companies not having line production are following the plan successfully.

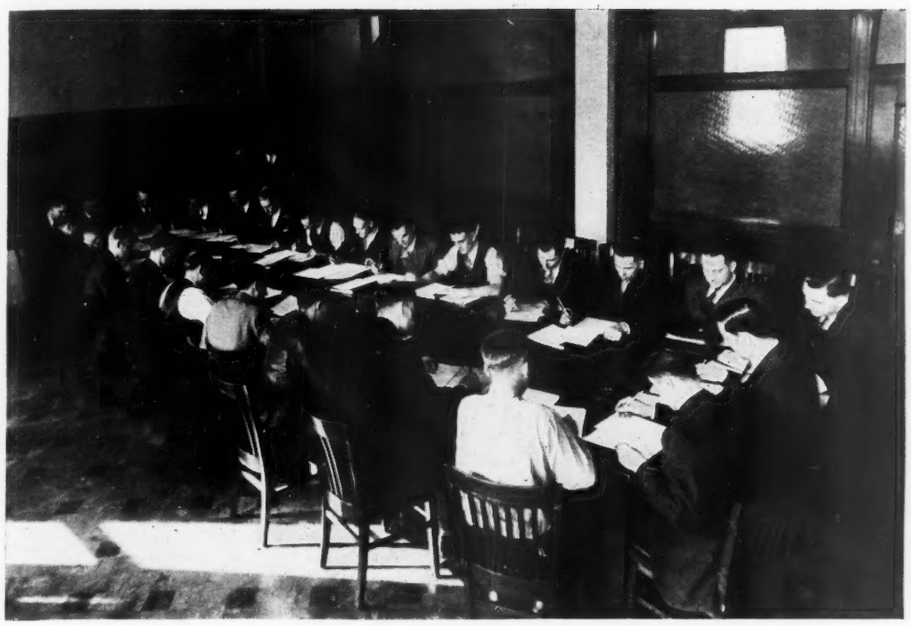
A tabulation of the results of the questionnaire is shown.

Objections

An analytical treatment of this sort should include the objections found to the plan by those responding. They based their objections on: (1) Lack of supervisory ability; (2) insufficient line assembly work; (3) too many operating variations; (4) preference for various premium plans; (5) the judgment that measured day work is not quick enough in improving the tempo of operators; (6) the charge that the plan does not get the best performance from the best operators; (7) inapplicability to complicated operations; and (8) the fact that they had not yet given the plan sufficient study. These opinions must be qualified by the fact that only two of the objections came from companies that had investigated actual applications.

The major objection of serious thinkers to measured day work has been the lack of supervisory ability in the ranks of foremen. But how many times have you tried throwing responsibility upon foremen and insisting upon its discharge?

Another objection stated was that measured day work is a "driver" rather than an "incentive." I believe that this objection is invalid because the plan has been applied successfully in highly competitive labor areas. However, the plan does require the right person on the right job, and facilitates doing every job in the best way possible.



Greatest needs seem to be training in the human relations phase of the foreman's job, greater familarity with company policy, a better understanding of current developments in economic and political thinking

Detroit Sends Its Foremen to School

Twelve automotive plants believe that foremen must be better leaders, take this method of making them so

C. B. GORDY
Detroit Editor

WORKMEN on the line and at the machine are smarter fellows than they used to be. The reason is simple. The bright young men who are coming into industry are no longer starting higher up. They are starting out in the shop. As a result, smarter supervision is needed, because as one plant manager put it: "As soon as a worker gets the idea that his superior is not smart enough to be his boss, cooperation is impossible. This is true whether we are talking about a vice-president or a foreman."

Obviously we shall want to talk here about foremen and especially about the practice that is rapidly becoming general of requiring them to follow some formal course of training. In short, it will be informative to examine into the purposes, methods, and results of a number of plans now in use. Data for this study were obtained from twelve of the larger manufacturing units of the automobile industry, including assembly, body, and accessory plants. In size, they ran all the way from 500 employees to several thousand.

First of all, it becomes plain from this study that supervisors need to be trained not so much in production techniques as in the cost and human relations aspects of their jobs. Many an old-time foreman fails to keep abreast of developments in economic and political thinking. For instance, there was a foreman who decided, not so long ago, to fire all men in his department with union affiliations. Fortunately the director of industrial relations had to approve all releases, thus avoiding what would have developed into a beautiful case of discrimination.

No Leaders, They

This foreman was a bit bolder than a foreman in another company who, in the face of a flagrant disregard of company rules, normally calling for discharge, gave only three days' lay-off through fear of creating trouble. Both instances indicate lack of leadership and sureness of purpose which can come only through close identification with the policy formulated for the conduct of industrial relations. It is the firm opinion of one executive, gained through talks with the workers, that a strike in his plant was due to lack of leadership in the foremen; the men wanted leadership and, not finding it, turned to those agitating for the strike.

While the above reasons for supervisory training rest rather heavily on the changed industrial picture since 1933, every company is always faced with difficulties through prejudice and lack of cooperation, and in a training program there is opportunity to do something about these. One company, with eight conference sections of twenty supervisors each, shuffles the membership at the end of a fixed number of sessions in order that its foremen may become acquainted and interchange information on production problems in the plant. Learning more of the difficulties facing other jobs than his own, the foreman be-

comes more tolerant and decidedly more understanding.

Of course the foreman is scarcely to be blamed individually for all these things; neither he nor anyone else in his position would know policy situations in industrial relations unless he were told. With a large number of supervisors and the natural limitations of the English language, diverse interpretations of a simple rule are almost bound to happen unless type problems arising under the rule are posed in conference and a collective answer is worked out. The necessity of measuring one's ideas and methods with those of others is a good way to prevent the development of the belief that everyone else is wrong.

Gone from today's industrial picture is the voluntary subscription for a course in foreman training, at least in the larger companies. The attitude generally is that of the president of a corporation having some 3,000 supervisors in conference once each week: "We need it, for it is as important as production and is a requirement of the job."

Established training programs may be interrupted now and then by special sessions—as, for instance, this one on sight conservation

Management's Backing Needed

This statement, by the way, displays a very necessary requisite in the whole training program — the backing and active participation of major management. The plans examined for this article adhere to this principle. In some cases, it is the president who initiates and supports the plan; in others, the vice-president in charge of operations, or perhaps the director of industrial relations, backed vigorously by a higher official.

Plans are of two major types — the one in which the material to be used in the conference is prepared by some one individual, usually the industrial relations man; the other, in which the material is cleared through a key group known variously as the steering committee, master session, or plant manager's group. In larger corporations, this key group consists of the leading operating executives of individual units. In one company it is composed of a representative from each of the major operating divisions, selected by the general foremen of each division.

Executives, Too

Three objectives may be noted in the use of this device. First, the major executives get the training, and the belief is not lacking that it is needed; second, the group aids in establishing the company policy in many instances; third, the leaders for the foremen conferences are selected from this group. The policy interpretation is concerned with labor and working conditions mainly, but questions such as this must be threshed out and settled before being passed on to the foreman: "How much may a foreman change a process?" The key group is found invaluable in settling questions that do not attain the dignity of major company policies but nevertheless are of vital importance to a smooth-running organization.

One plan of functioning with a key group may be used as typical. This group meets to discuss the topic at hand one week in advance of foremen conferences on the same subject. From this discussion three leading questions of policy are posed for foremen to answer, and the correct answers are established. Then the leader for the foremen sessions is selected. The three questions are duplicated and passed out to the foremen who must turn in written answers to them at the beginning of the conference period.

It is the leader's job to draw out the established answers from his foremen. No prepared material is given to the foremen to read before class. The plan in this respect differs from the general rule, because this concern believes it is impossible to get foremen to study and that the only hope is to get them to think in conference. A summary of the discussions covered in conference each month is given to the foreman as his permanent copy of company policy for the subjects covered.

Little uniformity seems to exist as far as number of sessions is concerned; generally they run through the winter. Invariably, however, they are held on company time, the composition of classes being arranged so that no division is crippled by absence of supervision. The number in each class runs from 15 to 20. One hour per session seems to be favored, although one large company uses two-hour sessions.

No Summer School

One plan calls for 40 weekly meetings, another for 10. One plan runs throughout the year, with Christmas and spring vacations and a month off during the summer. A company with a history of five years' supervisory training has 10 weekly meetings during the winter on some topic of importance at the moment; one year it was on general accounting, another year on duties of the foremen, and the past winter on labor.

The composition of classes is managed according to rank, the key group of major operating executives being separated from the foremen, and the latter from assistant foremen and job setters. The feeling is general that such a division leads to a free and unrestrained expression of opinion. A summary of the discussion in the foremen's groups is usually considered in the key group prior to the taking up of the succeeding topic, in order that there may be a free interchange of opinion.

The conference method is the favorite way of conducting classes. Where a key group is provided, conference leaders are selected from its membership. In some cases the educational directors conduct all classes; or, when some special subject such as time study is under discussion, the head of that department, who is a member of the key or master group, is usually designated as the leader for that particular session.

Better than a Bonus

Is Idaho Maryland Mines Corporation's method of sharing profits, which provides additional compensation in proportion to dividends paid to stockholders

E. L. OLIVER
President, Idaho Maryland Mines Corporation
San Francisco

BONUSES are all right in their place. They provide one method — although frequently a somewhat haphazard one—of sharing profits with employees. But the better way, we think, is an agreement between employer and employees whereby the latter receive additional compensation in proportion to earnings received by stockholders. Details of our profit-sharing plan, adopted in December, are therefore set down here with the thought that they may be useful to some other concern endeavoring to develop a simple means of accomplishing the same end.

Our method is extremely easy to understand, thus successfully passing the first test of any good incentive plan. The directors have agreed to set aside, during 1937, an amount equal to the dividend on 150,000 shares of stock each time the corporation declares a dividend. This number of shares is equivalent to approximately 9 per cent of the present outstanding stock. For example, on declaring a 5-cent dividend, $7,500 will be set aside. These amounts will be placed in a fund for distribution on Dec. 15, 1937, among the qualified men in the corporation's employ on that date, as additional compensation for their services during the year.

Length of Service Counts

Each man who will have been continuously in the employ of the corporation for 6 months, but less than 1 year, prior to Dec. 15, 1937, will receive 4 units; each man with a continuous service record of at least 1 year, but less than 2 years, will receive 5 units; and each man with a continuous service record of 2 years or more will receive 6 units.

The value of each unit will be determined by dividing the total amount in the fund by the aggregate number of units. Assuming for the purpose of illustration that the profits of 1937 will equal those of 1936, it is estimated that on the basis of the present number of employees the qualified men's shares will vary between $80 and $120. If the corporation is able to pay 60 cents a share, each man's share will be from $120 to $180. Since the majority of our stockholders own less than 250 shares each, this additional compensation to employees will be greater than the dividends received by most of our stockholders.

It is to be noted that all men having the same length of service will share equally in the fund, irrespective of their regular wages or salaries. Of course, the amount of each man's share will vary with the number of qualified employees.

On Probation for Six Months

The board of directors adopted the 6-month period for qualifying to share in the fund as a probationary period during which a man may demonstrate his loyalty and efficiency. If experience during 1937 demonstrates that there has been a worth-while increase in efficiency and reduction in labor turnover, the directors hope to continue the plan. In any event, the man with less than 6 months' service in 1937 can look forward to sharing in the fund at the end of 1938 on the 5-unit basis.

Management, of necessity, reserves the right to determine the qualifications and classification of all its employees, and its judgment will be final. No employee will be penalized for absence on account of illness or other justifiable cause, and the management, in all proper cases, will issue leaves of absence to preserve the status of such employees under the plan. Any man who leaves his position before Dec. 15, 1937, except on written leave of absence for the whole period of his non-employment, or who is discharged before that date, is automatically eliminated from any participation in the plan.

Why Dividend Base was Chosen

Our object in using dividends rather than net profits as a basis for the plan has many obvious points of advantage. Net profits are subject to many uncertainties even several months after the ending of an accounting period because of questions of depreciation, depletion, and claims of various kinds which frequently are not settled for years. On the other hand, dividends actually paid are final and of public record.

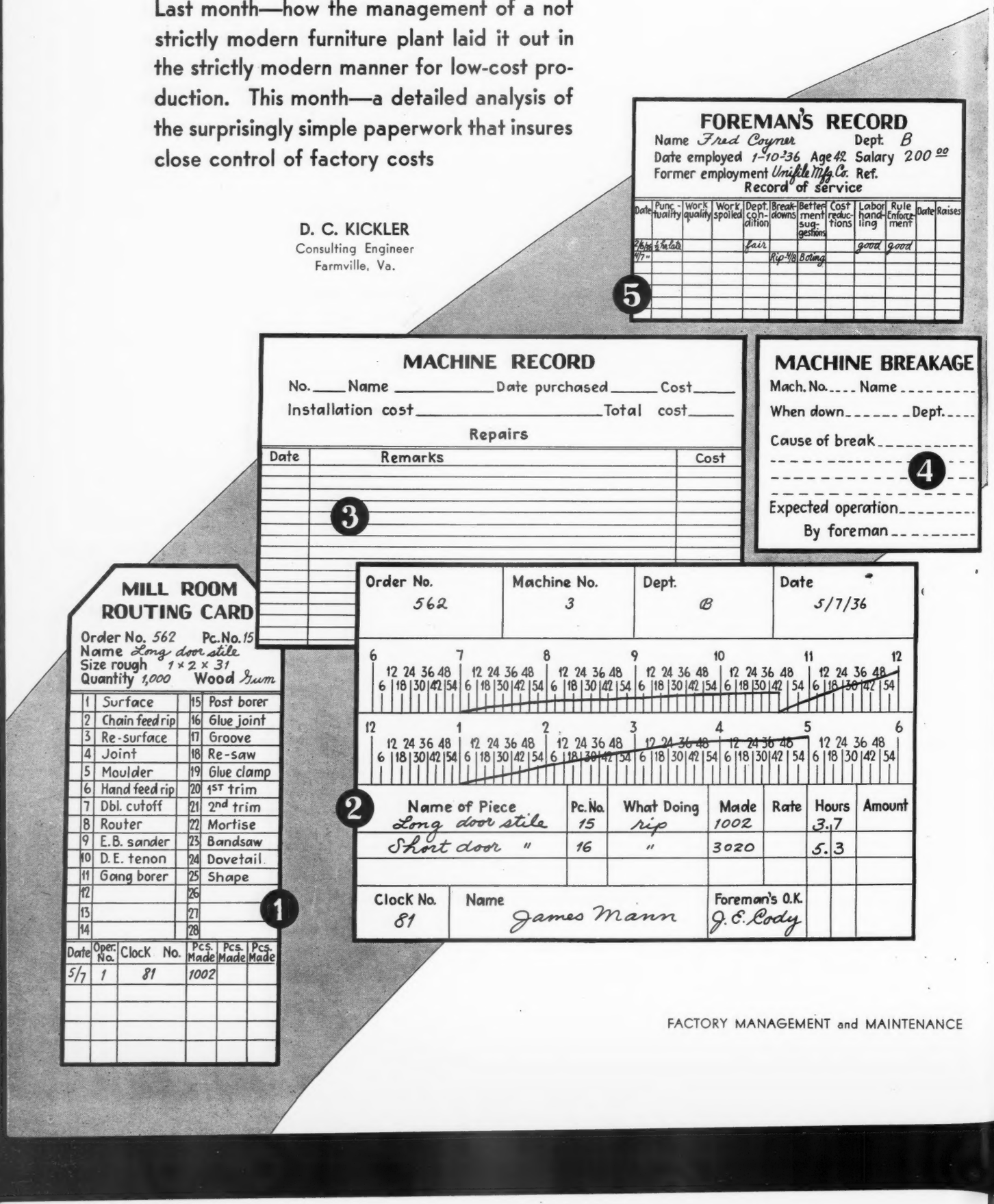
In this connection, a final point as regards our type of business should be mentioned: In most businesses, return of capital to stockholders must come out of net profits. However, in a mining company depletion provides for return of capital—at least theoretically. Thus moneys paid to stockholders out of *depletion reserve* are not considered dividends. Our employees therefore do not share in such distributions, nor is there equitable reason why they should.

Outlines of other profit-sharing plans are given on page S367 of "Employee Security" —a special section found on the buff pages just inside the back cover

Eight Pieces of Paper Enough to Run This Plant

Last month—how the management of a not strictly modern furniture plant laid it out in the strictly modern manner for low-cost production. This month—a detailed analysis of the surprisingly simple paperwork that insures close control of factory costs

D. C. KICKLER
Consulting Engineer
Farmville, Va.



FOREMAN'S RECORD

Name *Fred Coyner* Dept. *B*
Date employed *1-10-36* Age *42* Salary *200 00*
Former employment *Unifile Mfg Co.* Ref.
Record of service

Date	Punc.-tuality	Work quality	Work spoiled	Dept. condition	Break-downs	Better-ment sug-gestions	Cost reduc-tions	Labor handling	Rule Enforce-ment	Date	Raises
2/26/36	½ hr late			fair				good	good		
4/7"					Rip 4/8	Boring					

5

MACHINE RECORD

No.____ Name _____ Date purchased_____ Cost_____
Installation cost_____ Total cost_____

Repairs

Date	Remarks	Cost

3

MACHINE BREAKAGE

Mach. No.____ Name _____
When down_____ Dept.____
Cause of break_____
_____
_____ 4
_____
Expected operation_____
By foreman_____

MILL ROOM ROUTING CARD

Order No. *562* Pc. No. *15*
Name *Long door stile*
Size rough *1 × 2 × 31*
Quantity *1,000* Wood *Gum*

1	Surface	15	Post borer
2	Chain feed rip	16	Glue joint
3	Re-surface	17	Groove
4	Joint	18	Re-saw
5	Moulder	19	Glue clamp
6	Hand feed rip	20	1ST trim
7	Dbl. cutoff	21	2nd trim
8	Router	22	Mortise
9	E.B. sander	23	Bandsaw
10	D.E. tenon	24	Dovetail
11	Gang borer	25	Shape
12		26	
13		27	
14		28	

1

Date	Oper. No.	Clock No.	Pcs. Made	Pcs. Made	Pcs. Made
5/7	1	81	1002		

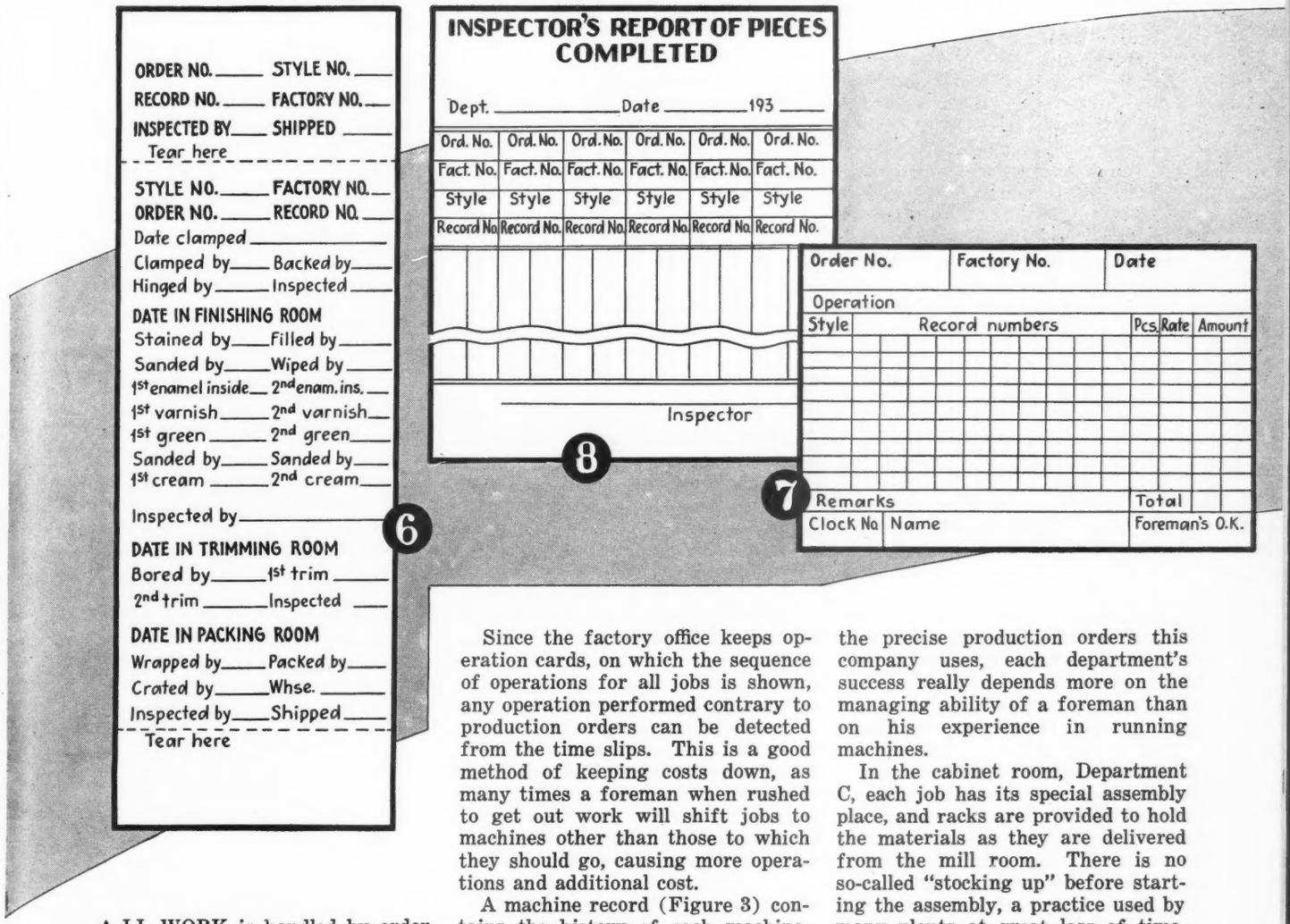
Order No.	Machine No.	Dept.	Date
562	3	B	5/7/36

6 7 8 9 10 11 12
12 1 2 3 4 5 6
12 24 36 48 | 6 18 30 42 54

2

Name of Piece	Pc. No.	What Doing	Made	Rate	Hours	Amount
Long door stile	*15*	*rip*	*1002*		*3.7*	
Short door "	*16*	*"*	*3020*		*5.3*	

Clock No.	Name	Foreman's O.K.
81	*James Mann*	*J. E. Cody*



ALL WORK is handled by order number. Orders are issued by the production department which prepares a routing card (Figure 1) for every piece to be made. On this card is found not only all information about each piece, such as name, number, size, and quantity, but also a list of operations to be performed on the piece. The card follows the job through the mill room operations and accompanies it to the cabinet room.

All employees punch the clock, and make out a daily time slip (Figure 2) showing what order number they have worked on, the work done, and the time spent on the job. Time slips are made out for both daywork and piecework. As a matter of fact, practically all work is done on a piecework basis, even trucking and piling. Slips are okayed by the foreman who in most instances makes out the time slips as he assigns the jobs. They next go to the timekeeper who checks them against the clock. Then they are entered on the payroll and turned over to the cost department.

Since the factory office keeps operation cards, on which the sequence of operations for all jobs is shown, any operation performed contrary to production orders can be detected from the time slips. This is a good method of keeping costs down, as many times a foreman when rushed to get out work will shift jobs to machines other than those to which they should go, causing more operations and additional cost.

A machine record (Figure 3) contains the history of each machine. These cards show machine number and name, date of purchase, cost, and a list of repairs made with their cost. Should a machine break down, it is the foreman's duty to notify the production department at once on a machine breakage form (Figure 4), as it may cause a change in operations to avoid stopping production. The foreman must indicate the time of breakdown and the approximate time that operation will be resumed. This last item tends to make the foreman hurry repairs.

If a Foreman Asks for a Raise

Still another record kept is the foreman's record (Figure 5). This shows a record of the man's employment, and lists incidents occurring from time to time that speak for or against him. Should a foreman ask for a raise, he and the superintendent are called to the general manager's office, and his request can be granted or refused largely on the basis of this record.

This record is claimed to promote efficiency of department heads. With the precise production orders this company uses, each department's success really depends more on the managing ability of a foreman than on his experience in running machines.

In the cabinet room, Department C, each job has its special assembly place, and racks are provided to hold the materials as they are delivered from the mill room. There is no so-called "stocking up" before starting the assembly, a practice used by many plants at great loss of time. Work in this department is practically all piecework.

Sticks with the Piece

After each case has been glued and clamped, an operation card (Figure 6) is glued to the back. This card stays with the piece all the way to the warehouse. It is made out in the production department, and sent to the cabinet department to be attached. Near each end are perforations so that the major portion of the tag can be torn off and returned to the production department when work on the case has been completed, leaving a small upper part glued to the case with data necessary for identification.

Figure 2, described earlier, is the daily time slip used in Department C. All materials needed to carry out the assembly are requisitioned from the stockroom. Cases are pushed, one behind the other, past the drawer assembly benches, where they are inspected and the drawers put in.

The complete assemblies are pushed in a line to the finishing

room. Smaller products are assembled and put on special steel trucks, inspected, and then pushed into the finishing room. If a shortage occurs, it is necessary for the foreman to issue a shortage order to the production department on the order number and parts involved, showing the cause. Thus possible material waste is kept down.

Next is the finishing room, Department D. Cases go on through their operations listed on the operations card, each operator marking his initials beside the operation he completes. Spray men, however, use a different time slip, shown in Figure 7, as the different order numbers become badly mixed during the several finishing operations which require several days. This enables the production department to keep track of and trace each individual order number to see that the entire order has been completed, and that no employee turns in work he has not performed. The operator can fill in the information called for on Figure 7 without any loss of time.

A Check on Materials

Smaller products continue through their respective operations on the trucks. All enamels, varnishes, and other materials used are requisitioned from the stockroom. The cost department keeps a record of pieces finished which it uses to check against the amounts of material used. All products are inspected as they pass to the next department.

This is Department E, the fitting room. Here hardware is put on, and each employee checks the operation he performs by marking his initials in the proper place on the operations card, Figure 6. On the smaller products the time slip shown in Figure 2 is used. Operations are practically all done on piecework.

Once it has passed through this department, each product is complete and is carefully inspected. The form shown in Figure 8 is provided for this inspection. Under order number appears the amount called for in the production order, and under record number is entered the quantity checked. These figures serve as a check that each order number has been completed, and a check on the operations done by each employee.

Department F, the packing room, is next. As the products are wrapped and packed, the packer marks his initials on the form shown in Figure 6, beside the operation he performs. The major portion of the form is torn off the case, and the foreman sends it to the production department, where it is checked and recorded against the quantity specified in the original order sent to the mill room. The stub of the form remains glued to the back of the case with sufficient data to check the work on that case in the event that a customer finds it unsatisfactory and complains.

Once wrapped and packed, products are sent to the warehouse or to the shipping platform. Piecework is the predominating method of payment, and the time slip used is that shown in Figure 7. Daywork employees use the card shown in Figure 2. All materials and equipment are requisitioned from the stockroom, and a record is kept and tabulated at the end of each month to be checked against the monthly production, in order that material wastes can be detected.

Last department through which products pass is the warehouse and shipping, known as Department G. Here products are stored until loaded onto cars. The men are on a piecework basis. As the cars are loaded or the goods stored, the shipping clerk checks them against the attached stubs. By using a piecework basis for payment, danger of any surplus and idle labor is averted, a condition often prevalent in warehouses and shipping departments. The foreman keeps a record of all goods received and shipped, providing a convenient inventory for the sales department.

Perpetual Inventory

The stockroom, or Department H, fills all requisitions for materials and supplies from the different plant departments. Record is kept of receipts and deliveries, providing as near a perpetual inventory as possible. However, all equipment and supplies are arranged so that an inventory can be taken in about 30 minutes. Such an inventory is taken at the end of each month as a check on material loss. The stockroom employees are on a daywork basis.

The power plant is known as Department K, and employees are on a daywork basis, hence, use the time record shown in Figure 2. Men here consist only of the day firemen and the night watchman, who keep up steam for the dry kilns and heating plant. Only waste materials are burned, a special bin having been arranged in which to collect the sawdust and shavings for firing at a time when the mill room is not operating. The plant purchases its electric power.

Timekeeping is handled by Department L. Time slips are checked against the clock, and entered in the payroll books with piecework and daywork amounts kept separate in order to show the proportion of piecework to daywork. The ratio is usually about 90 per cent of the former to 10 per cent of the latter. Since it has been found that piecework increases production and lowers manufacturing cost, the general manager watches this ratio closely. A report is made to him at the end of each period so that he in turn can report it to the president of the company every four weeks.

Controlled Production

Next to last but far from least is Department M, production, under the production engineer. He receives his orders from the general manager. This department plans production, makes out the forms shown in Figures 1 and 6, and sends them to the proper departments. A record is kept of all the orders by order numbers. This record is checked from the forms shown in Figures 1 and 6, and rechecked from those in Figures 7 and 8. The machine record is also kept here. The production engineer serves as assistant superintendent in the factory, and has complete control of production and methods.

Department N, the factory cost department, is last. To it come all time and materials slips. All data are compiled and costs computed for each order. Factory overhead is figured by the cost department, administrative overhead by the general manager's office. Costs are also figured on proposed new products, and the figures arrived at have proved quite accurate in practice. The cost department also has charge of the monthly inventory check and changes in piecework rates.

AVAILABLE NOW
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Factory
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•
Address the Editor

Safety in 4 Acts

★

J. T. BROWN
Safety Supervisor
DuPont Rayon Company
Old Hickory, Tenn.

FOR those who recognize the need for carrying safety education beyond the gates of the plant, I recommend a campaign based on the "After the Whistle Blows" plan developed by the National Safety Council. We used a modification of that plan in a campaign that lasted four months, and are perfectly certain that the results, although intangible as usual, justified the effort.

Some 5,100 employees were divided into two teams — a "Red" team composed of those having odd numbers on their clock cards or yearly passes, and a "Green" team made up of those with even numbers. Other methods of choosing sides would work equally well.

To interest each employee's family, a letter was addressed and mailed to housewives. A special activity was then assigned to each of the four months.

ACT I—SEPTEMBER
Home Inspection

Inspection blanks were distributed to all employees, with a list of ten items to be checked—for instance, matches, rubbish, poison bottles, guns and knives, gasoline, etc. Credit was given to the Reds and Greens for each blank signed and returned.

ACT II—OCTOBER
Automobiles and Traffic

First, two mass meetings were held. Credit for attendance was allowed. Each employee who owned an automobile was then given an inspection blank listing seven items essential to safe operation. If he inspected his own car, signed and returned the blank, his team received one point. If he had his car inspected by a competent mechanic and had his blank signed by the latter, his team got two credits.

ACT III—NOVEMBER
First Aid

Demonstrations were given by Boy Scouts of general first aid, such as bandaging, rescuing from burning buildings, splinting, etc. Meetings were addressed by a member of the plant medical department. Credit was given for attendance at these meetings.

ACT IV—DECEMBER
Home Hazard Survey

Each employee got a letter listing three hazards in the home. Credit was given for lists showing ten home hazards. Prizes of $5, $3, and $2 were given the employees who turned in the most complete lists.

During the campaign, seven reproductions of Safety Council posters were distributed in pay envelopes. Credit was allowed every employee who turned in a bulletin board approximately 12 x 15 inches on which these seven small posters were arranged. Prizes of $5, $3, and $2 were given for the boards. The response was so great that five additional $1 prizes were awarded.

INDICATIONS of employee interest may be seen in the fact that 80 per cent of all employees participated in the September phase of the program. The Reds scored 2,398 points to the Greens' 2,292 in the October car inspections. First-aid meetings were not so popular, only 25 per cent of employees attending, but 47 per cent submitted bulletin boards and 43 per cent turned in lists of home hazards. In case anyone wants to know what the final outcome was, the Reds won.

Housewife gets letter

Driver gets certificate

Schoolboy gets whistle

Boy scout gets first aid

You want to know

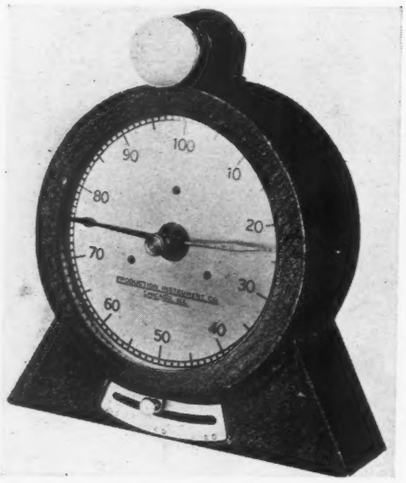
and the editors will gladly tell you more about the things mentioned on this page

• SOCIAL SECURITY record forms enable small and large employers to set up their new bookkeeping without puzzling over legal phraseology of the law. Individual payroll, unemployment tax, employees' contributions records, and annual payroll summary are some of the forms provided. (2701)

• HEAT-INDICATING PAINTS — they change color when exposed to heat — come in five permanent-change and seven retroactive types. Former change permanently at temperatures ranging 300-734 deg. F.; latter change at temperatures between 122 and 464 deg. F. but go back to original color when cooled. (2702)

• TO HELP YOU with that survey of your plant wiring, there is a manual outlining procedure. It provides forms for recording findings, and gives recommendations for plotting existing layouts, planning new ones. (2703)

• LIGHT CONDUCTOR, transmitting light in the way a wire does electricity, is obtained in a new thermoplastic resin. Light can be taken around bends and along intricate paths with no radiation from the sides. You can cut, mold, and saw the material. (2704)



WHEN the light goes on it's time to stop. Designed for timing laundry operations, this production guide is adapted to several manufacturing operations. After time interval has been set, the light flashes regularly to pace production (2722)

• DEPRECIATION RESERVE policies are recommended and outlined in a pamphlet resulting from a committee study. Effects of recent legislation and timely suggestions for executives are included. (2705)

• SMALL DUPLICATOR, inexpensive, can earn its way on those small jobs you need done. Uses a gelatin film; operated by working impression roller with one hand while paper is positioned with the other. (2706)

• YOU'LL PROBABLY WANT a copy of "The Performance of Unionism in Heavy Industry." It's a sequel to the booklet described on this page in November, shows income, employment, and purchasing power trends in six major heavy industries. (2707)

• TRANSFER CASE for storing or moving records or correspondence is made of enamel-finished welded steel. Said to be dust, vermin, and fire resisting. Letter size. (2708)

• INDIRECT LAMP is so designed that it can be used above shiny surfaces or glass desk tops without having its light reflected into user's eyes. Can be had in desk model or for bracket mounting on walls and tables. (2709)

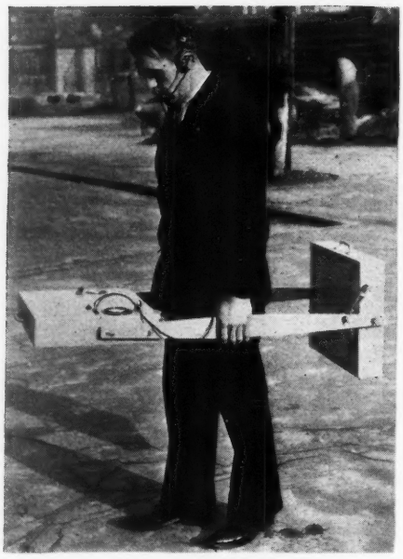
• RESIN, colorless and transparent, soluble in most commercial solvents except alcohol and water, has many uses. Because of its great light stability it is especially adapted to manufacture of white enamels. (2710)

• INDEX, telephone or otherwise, works at touch of button. You move a pointer to the initial you want, press the button, and it opens to the right page. Room for 800 names. (2711)

• FOR EMPLOYEES who want to keep a record of earnings and salary deductions under the social security law, employers can obtain special small account books. (2712)

• FILING CABINET, all steel, has rounded edges. Available with 2, 3, or 4 drawers, legal or letter size. (2713)

• SCALE for office or household use has range of 11 pounds. It is of modern design, with mechanical parts inclosed in plastic housing. (2714)



TREASURE HUNTING EXPEDITIONS will take along this instrument in the future, for it detects, locates, and measures depths of buried metal objects. One man can operate it in some cases, with transmitter and receiver rigged as shown here. For other services, two men work together, one on each unit (2723)

• DEVICE, attachable to any standard typewriter, makes 2 to 4 originals, not carbons, at one typing. Each copy is typed from a separate ribbon. (2715)

• LUBRICANT and plasticizer for glues, gums, shellac, casein, etc., is a light yellow liquid. It's soluble in water, non-hygroscopic, not sticky—doesn't dry or crystallize. (2716)

• LESSONS IN ARC WELDING, 44 of them, you can have in a book available for a moderate fee. New and much enlarged edition of an earlier work, it is based on an actual training course for welders. (2717)

• IF you have to determine quantities remaining in 54-gal. drums, you can obtain charts illustrating a simple method of doing the trick. (2718)

• PAILS made of Monel metal, which means they are corrosion resistant, are now graduated so that one can measure their contents. Made in 12-, 14-, and 16-qt. capacities. (2719)

• IODINE that is said to be stingless, non-poisonous, non-burning, yet powerful, sounds like something you should add to your first-aid supplies. (2720)

• WATERPROOFING MATERIAL holds tenaciously to almost any material, is acid, alkali, and oil resistant. It bakes quickly, air dries slowly. (2721)

It Paid to Revamp Our Power Drives

JAMES N. SKINNER
General Superintendent
The Skinner Chuck Company
New Britain, Conn.

WHEN we started a campaign to reduce expenses by increasing the efficiency of operation, our methods of obtaining and transmitting power were examined very carefully. As a result, a number of radical changes were made that have afforded important advantages, in addition to a considerable saving in operating cost.

The plant is housed in a four-story building 50 ft. wide and 315 ft. long, which is separated by a fire wall into two sections of approximately equal length. For many years our power requirements were supplied by a steam engine located in the basement. Although it was rated 100 hp., the load was often much higher. Steam was generated by two hand-fired boilers rated 100 and 150 hp. respectively. The engine was belted to a jackshaft 5 in. in diameter in the engine room. This jackshaft in turn was belted to a lineshaft about 265 ft. long, which ran nearly the entire length of the basement.

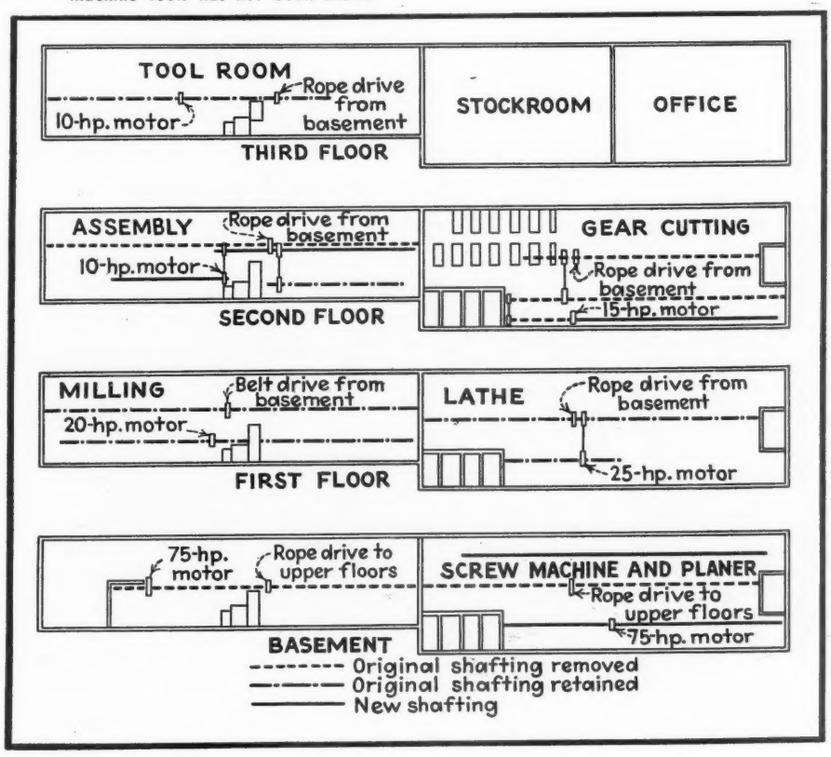
On the first floor there was a total of 410 ft. of lineshafting; on the second floor, 440 ft.; and on the third floor, in the tool room, 110 ft. of shafting. These lineshafts were operated at 155 r.p.m. through rope drives from the main shaft in the basement, as shown in the diagram. A total of about 185 machine tools of various kinds, including those in the tool room, were driven from these lineshafts, usually through a countershaft.

Lack of flexibility and a heavy friction load were remedied by providing separate group drives for each department

Our first move was to replace the engine with a 75-hp. motor and purchase energy from the local utility. This move reduced expenses considerably. Since we do not require steam for process work, both boilers are now shut down during all of the warm season. In winter one boiler is fired at a few pounds pressure and the steam is circulated through the heating system by a small vacuum pump which is located in the return line.

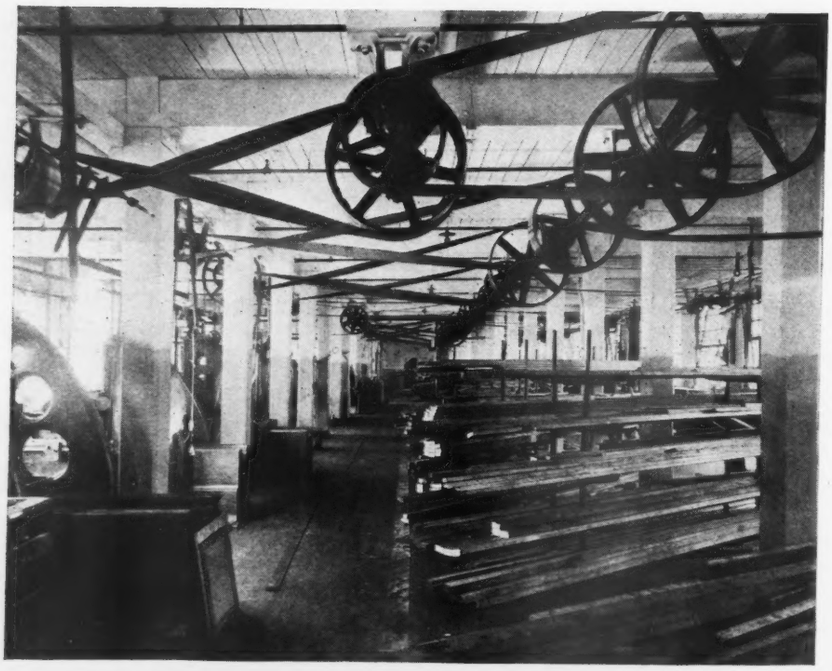
It was obvious, however, that a good deal of power was being wasted by the methods employed to transmit it from floor to floor and to the various machines. As machines had been added or shifted from time to time, they had been connected up in the most convenient way, but the final result of all the changes and additions over a period of many years was a pretty complicated arrangement which in many respects did not conform to modern ideas and practice. Plain babbitted bearings were used throughout on the line- and countershafts. We were fully aware, too, of the virtual impossibility of keeping long lineshafts properly aligned. Incidentally, a check made on the main shaft in the basement before it was taken down showed that it was more than an inch out of line.

Original layout of main lineshafts, with the changes that were made in forming departmental group drives. For simplicity, the location of countershafts and machine tools has not been shown

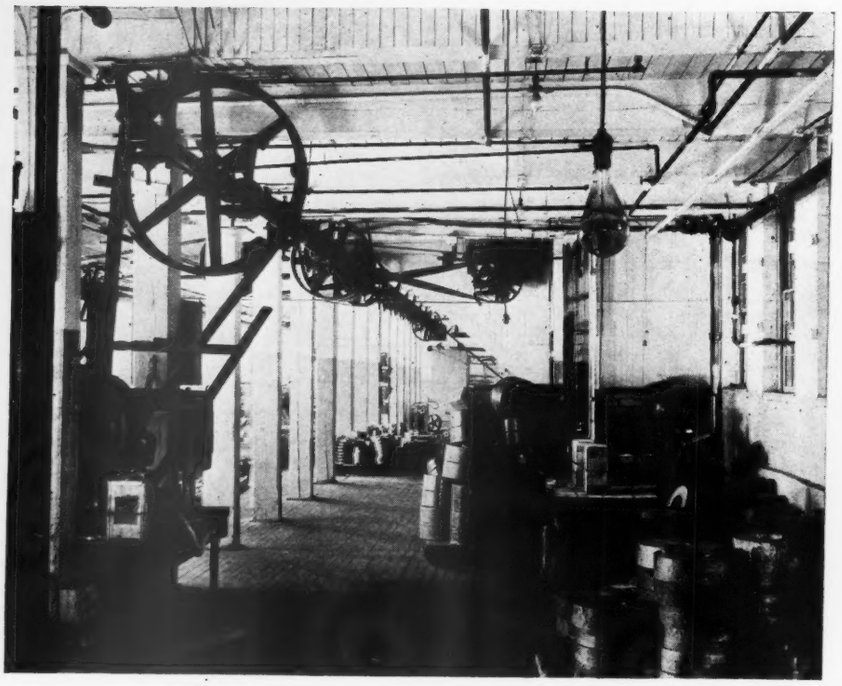


Determining the Load

In order to determine the friction load and the total working load under different conditions, a graphic wattmeter was cut into the circuit of the 75-hp. motor. By means of existing clutches it was possible to connect or disconnect the shafting in each department. Readings were taken under no load but with all clutches in; then beginning with the top floor each lineshaft clutch was thrown out until only the main line-



Top, a typical arrangement for driving machines at the sides of the building from the main lineshaft. It was simplified, middle, by taking out the main shaft and driving the shafts over the machines by separate motors



Right, main lineshaft in basement went on and on for 265 ft. At the left is the 75-hp. motor that replaced the steam engine, located in an adjoining room at the right. All of the shafting in this section was removed

shaft in the basement was running.

Under these conditions the following loads were recorded:

Location	*Horsepower Required*
Toolroom	2.7
Assembly room	3
Gear cutting	3.9
Milling	4
Lathe	3.7
Basement	37
Total	54.3

Average day working load, on all floors, was found to be 80 hp., while the load at night, during which only the basement and milling rooms operate, was 54 horsepower.

No Question of Need

With the definite knowledge that 54 hp., the equivalent of the night load, was required merely to keep the lineshafts turning, there was no question about the need for power drive modernization. It became merely a question of how far to go. Complete modernization of all drives at once would have involved a heavier investment than we cared to make; furthermore, it would have been difficult to avoid serious interference with production. Eventually there was worked out a list of changes to be made immediately, which it was estimated would return the investment cost in two and one-half years. At the same time these changes were coordinated with a program of modernization which may require years to complete.

Omitting some of the minor de-

tails, the main lineshaft in the basement was taken down and arrangements were made to drive the shaft in each department by one or more motors. All rope drives between floors were discarded.

An elevator in the basement, formerly driven by belts from the main lineshaft, was taken out of service with relief to everyone, because it had been the cause of much trouble. A vertical turret lathe and a multiple spindle drill were arranged for individual motor drive.

Two New Shafts

In the automatic screw machine and turret lathe department located in the basement at the front of the building the main shaft was taken down; two new ones were erected. These shafts, which are supported in ball-bearing hangers, are driven by a 75-hp. motor. Some of the old countershafts were eliminated, but certain others had to be retained.

The old main lineshaft in the milling machine department was removed along with 20 countershafts, and two new shafts were put up. They are driven by one 20-hp. motor and connected by a counter belt, but it is expected that when the load increases in the future the counter belt will be removed and another motor installed. All except six of the 20 machines in this department are driven directly from one of the lineshafts. Shaft clutches were provided for five machines.

Part of one old shaft in the lathe room was removed and a 25-hp. motor installed to drive the remaining long shaft and a shorter one.

In the assembly department two short shafts, driven by a 10-hp. motor, replaced the old, long one.

Similar changes were made in the gear cutting department, a 15-hp. motor being installed to drive two fairly long shafts.

As said before, the changes thus far made represent only a part of those that will ultimately be put through. Arrangement and layout in several of the departments are by no means ideal, but even so they represent a decided improvement over former conditions.

To date we have installed 40 new ball-bearing hangers, 45 pressed steel lineshaft pulleys, 326 ft. of 2-3/16-in. shafting, and 8 new motors ranging from 5 to 30 hp. The total cost of these changes, including allowances for the salvage value of the old equipment, was about $5,000.

Production Went On

Incidentally, careful planning and scheduling made it possible to put through all these changes without any interference with production, except in one department, where a few hours' time was lost while certain machines were being relocated and the drive connections installed.

Advantages gained by these changes are important. In addition to the obvious reduction in power that was formerly wasted, the present method of driving each department separately provides a flexibility that was entirely lacking before. Any department can now be operated with high mechanical efficiency independently of all other departments. With comparatively small groups of machines in each department driven by one motor, there is little waste of power when one or several machines are idle.

Did We Save?

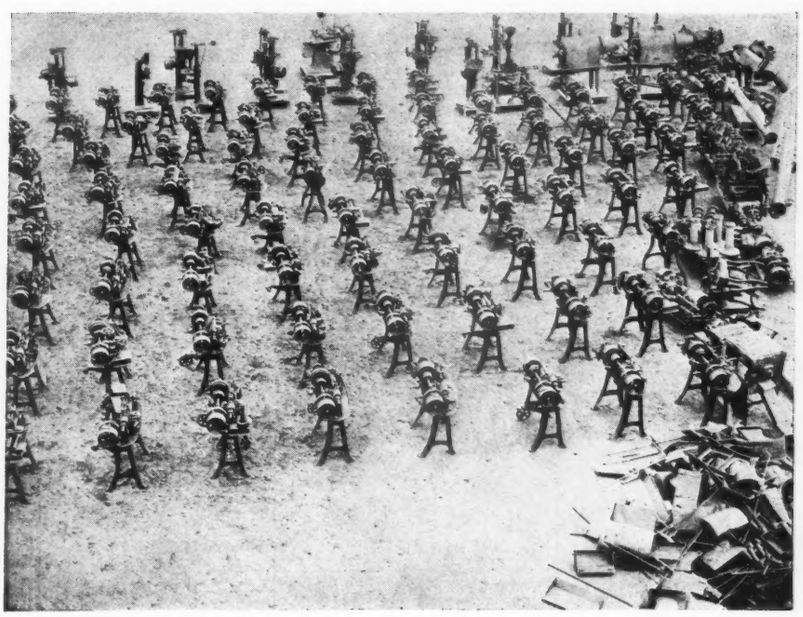
Savings will doubtless be considerable, but at present it is impossible to estimate them accurately. One reason is that we have been operating for such a short time with the new layout that comparison of present with past power bills has not been possible. Aside from the savings in power, the use of ball-bearing shaft hangers, which require greasing only once or twice a year, will make a substantial saving over the former cost of oiling. There will also be a reduction in the cost of maintenance attention required to keep the drives in proper condition, shafts aligned, and so on. Raising lineshaft speed will make it possible to step up production.

Finally, our investment in belting has been materially lowered. Simplification of the drives and elimination of many countershafts reduced the number of belts in service. Furthermore, none of the belts now in use has to transmit more than 25 or 30 hp., whereas several of the old drives, particularly from engine to jackshaft and from jackshaft to main lineshaft, transmitted large amounts of power and were very heavy and expensive.

They Take Their Own Medicine

A MAKER of roller chain drives, the Diamond Chain & Manufacturing Company of Indianapolis has frequently pointed out the waste that results from the use of inefficient equipment. Recently it gave its own plant a thorough going over, scrapped more than 49 tons of machine tools, sold them at scrap prices that averaged $10 a ton.

All this happened, mind you, in a plant that could in no sense be labeled inefficient. So marked has been recent progress in equipment development that the same thing could happen almost anywhere.



Standard Procedure for Mechanical Department

FREDERIC OAKHILL
Plant Engineer, Bauer & Black, Chicago

I. Purpose of Procedure

THE PURPOSE of this procedure is to define the organization, responsibilities, and execution of work of the Mechanical Department.

II. Of Concern to

The entire plant personnel.

III. Forms Used

1. Repair Request
2. Budget Order
3. Requisition
4. Stores Issue
5. Stores Credit
6. Time Ticket

IV. Statement of Organization

The Mechanical Department is composed of the following groups:

1. Electrical crew
2. Steamfitters
3. Machinist
4. Carpenters and millwrights
5. Painters

V. Statement of Responsibilities

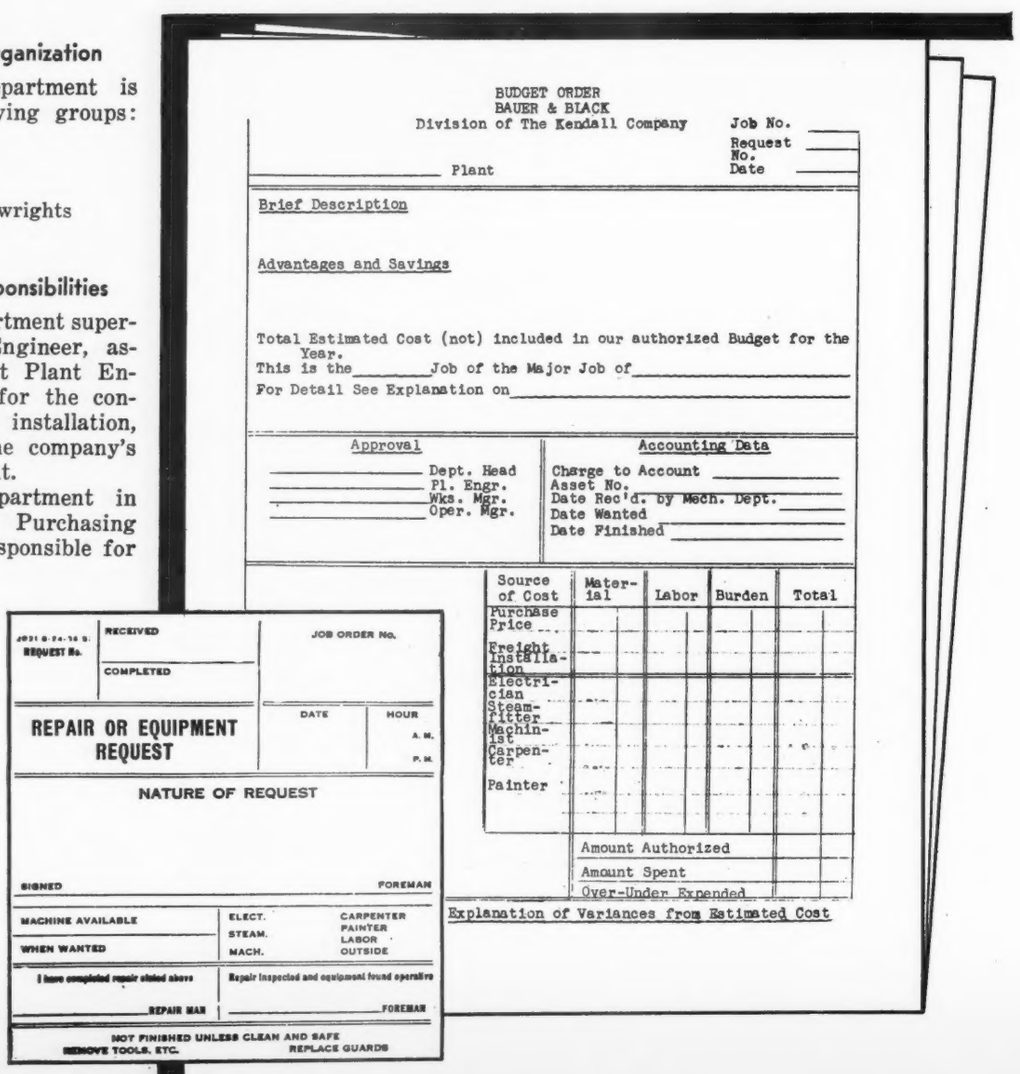
The Mechanical Department supervised by the Plant Engineer, assisted by the Assistant Plant Engineer, is responsible for the construction, alteration, installation, and maintenance of the company's buildings and equipment.

The Mechanical Department in conjunction with the Purchasing Department shall be responsible for the securing of services, materials, and supplies of a mechanical nature for any and all other departments.

1. *Electrical Crew*—the electrical crew, supervised by the Chief Electrician, shall be responsible for the installation, operation, alteration, maintenance, and scheduled inspection of all electrical and related equipment throughout the plant properties.

The following list includes the important items of the Chief Electrician's responsibilities:

a. Electrical lighting system
b. Electric power system
c. Communication systems
d. Elevator equipment
e. Fire alarm system (electrical equipment)
f. Attendance and recording clock system
g. Electrical apparatus that forms a part of any piece of equipment
h. All miscellaneous electrical work done about the plant
i. Oiling of all electrical motors and equipment
j. Lamp washing and lamp replacement
k. All records of electrical equipment and inspections (in conjunction with Plant Engineer)



BUDGET ORDER
BAUER & BLACK
Division of The Kendall Company

Job No. ____
Request No. ____
Date ____

____ Plant

Brief Description

Advantages and Savings

Total Estimated Cost (not) included in our authorized Budget for the Year.
This is the ____ Job of the Major Job of ____
For Detail See Explanation on ____

Approval
____ Dept. Head
____ Pl. Engr.
____ Wks. Mgr.
____ Oper. Mgr.

Accounting Data
Charge to Account ____
Asset No. ____
Date Rec'd. by Mech. Dept. ____
Date Wanted ____
Date Finished ____

Source of Cost	Material	Labor	Burden	Total
Purchase Price				
Freight				
Installation				
Electrician				
Steamfitter				
Machinist				
Carpenter				
Painter				
Amount Authorized				
Amount Spent				
Over-Under Expended				

Explanation of Variances from Estimated Cost

REQUEST No. ____ RECEIVED ____ COMPLETED ____ JOB ORDER No. ____

REPAIR OR EQUIPMENT REQUEST

DATE ____ HOUR ____ A. M. P. M.

NATURE OF REQUEST

SIGNED ____ FOREMAN

MACHINE AVAILABLE ____ WHEN WANTED ____
ELECT. STEAM. MACH. CARPENTER PAINTER LABOR OUTSIDE

I have completed repair stated above ____ REPAIR MAN
Repair inspected and equipment found operative ____ FOREMAN

NOT FINISHED UNLESS CLEAN AND SAFE
REMOVE TOOLS, ETC. REPLACE GUARDS

2. *Steamfitters*—the pipe shop, supervised by the Chief Steamfitter, shall be responsible for the installation, operation, alteration, maintenance, and scheduled inspection of all utility services other than electrical and those under the Chief Operating Engineer.

The following list includes the important items of the Chief Steamfitter's responsibilities:

a. Steam and return piping
b. Hot and cold water piping
c. Compressed air piping
d. Other miscellaneous piping
e. Heating, ventilating, and air conditioning equipment
f. Sprinkler system and fire fighting equipment
g. Drainage and sewer systems
h. Plumbing
i. Pumps and pumping equipment
j. Refrigerating equipment
k. Dust removal systems and pneumatic industrial material conveyors
l. Sheet metal work
m. Scales and weighing equipment
n. Numbering of plant assets (in conjunction with the Plant Engineer)

3. *Machinists*—the machine shop, supervised by the Chief Machinist, shall be responsible for the construction and installation of new machinery, operation, maintenance, and scheduled inspection of all mechanical production equipment other than that under the Boss Carpenter.

The Master Mechanic will have an advisory supervision capacity over the machine shop activities.

The Master Mechanic, not normally a member of the Mechanical Department, is responsible for the design and improvement of all mechanical production machinery and equipment.

4. *Carpenters and Millwrights*—the carpenter shop, supervised by the Boss Carpenter, shall be responsible for the construction, installation, alteration, maintenance, and scheduled inspection of all building work, cabinet work, and millwright work.

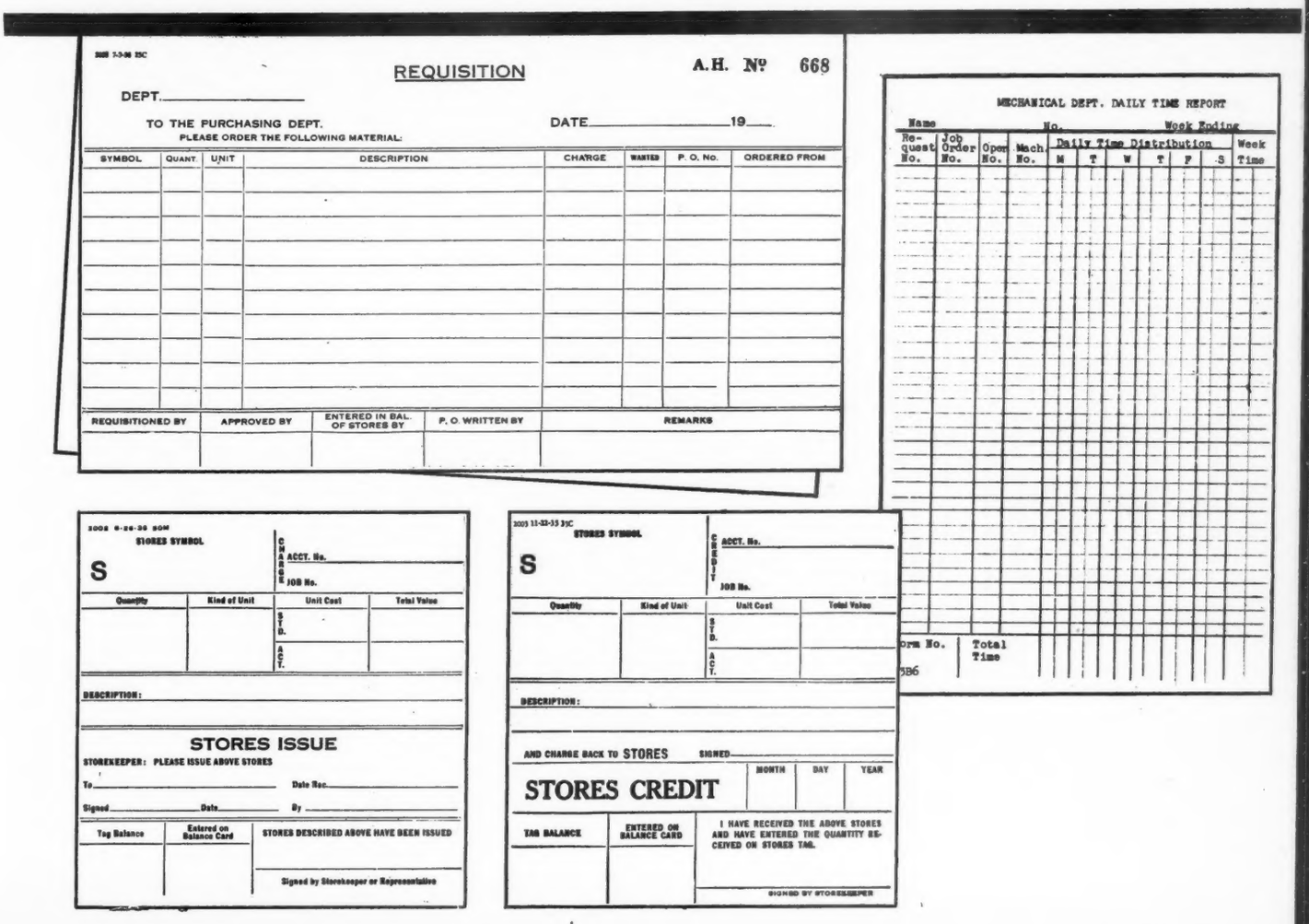
The following list includes the important items of the Boss Carpenter's responsibilities:

a. Roofs and roof structures
b. Fire escapes and outside building equipment
c. Window frames and sash, including glazing, doorways, doors.
d. Building structures
e. Floorings
f. Fences and retaining walls
g. Railroad siding and track
h. Loading platforms
i. Sidewalks and other pavements
j. Cabinet work and experimental devices made of wood
k. Production equipment made of wood (in conjunction with the Master Mechanic)
l. Belt drives and line shafting
m. Mechanical conveyors and hoists
n. Miscellaneous work requiring a carpenter or millwright
o. Members of labor gang when not assigned to other crews

5. *Painters*—the paint shop and crew, supervised by the Boss Painter, shall be responsible for the painting and maintaining of all painted surfaces and window shades throughout the entire plant properties.

VI. Execution of Procedure

1. *Initiation of Work Order*—a request for services of the Mechanical Department for labor, equipment, and supplies must be made by the use of a *Repair Request* in duplicate, duly filled in and signed by a person authorized to do so for the partic-



REQUISITION

A.H. Nº 668

DEPT._____

TO THE PURCHASING DEPT. DATE_____19____
PLEASE ORDER THE FOLLOWING MATERIAL:

SYMBOL	QUANT.	UNIT	DESCRIPTION	CHARGE	WANTED	P. O. No.	ORDERED FROM

REQUISITIONED BY	APPROVED BY	ENTERED IN BAL. OF STORES BY	P. O. WRITTEN BY	REMARKS

MECHANICAL DEPT. DAILY TIME REPORT

Name _____ No. _____ Week Ending _____

Request No.	Job Order No.	Oper. No.	Mach. No.	Daily Time Distribution M	T	W	T	F	S	Week Time

Form No. 586 | Total Time

STORES SYMBOL

S

CHARGE ACCT. No. _____ JOB No.

Quantity	Kind of Unit	Unit Cost	Total Value
		STD.	
		ACT.	

DESCRIPTION:

STORES ISSUE

STOREKEEPER: PLEASE ISSUE ABOVE STORES

To_____ Date Rec._____

Signed_____ Date_____ By_____

Tag Balance	Entered on Balance Card	STORES DESCRIBED ABOVE HAVE BEEN ISSUED
		Signed by Storekeeper or Representative

STORES SYMBOL

S

CREDIT ACCT. No. _____ JOB No.

Quantity	Kind of Unit	Unit Cost	Total Value
		STD.	
		ACT.	

DESCRIPTION:

AND CHARGE BACK TO STORES SIGNED_____

STORES CREDIT

MONTH | DAY | YEAR

TAG BALANCE	ENTERED ON BALANCE CARD	I HAVE RECEIVED THE ABOVE STORES AND HAVE ENTERED THE QUANTITY RECEIVED ON STORES TAG.
		SIGNED BY STOREKEEPER

ular department requesting these services.

The Mechanical Department may not do work or order materials without the authorization of a properly filled-in *Repair Request.*

The *Repair Request* must clearly state the work to be done or materials ordered, giving machine number, location, etc., to enable an economical handling of the order. If the front of the *Repair Request* is not large enough for an adequate description of the request, then sufficient additional data including drawings, when necessary, must accompany the *Repair Request.*

The *Repair Request* is given to the dispatch clerk in the Mechanical Storeroom. The dispatch clerk shall then be responsible for prompt distribution of the orders to the several supervisors involved. The *Repair Request* is never to be given to any other person than the dispatch clerk except in extreme emergency requiring immediate action. In this case a phone call to the dispatch clerk for a mechanic should be made. However, a properly filled-in *Repair Request* must be given the mechanic before he leaves the job.

2. *The Budget Order*—the *Budget Order* is used for all job orders costing in excess of $10; all job orders costing less than $10 are charged against the burden center account number covering the work.

The *Budget Order* is of two classifications:

Capital Charges
Expense Charges
- A. Routine Maintenance Work
- B. Unusual Maintenance Work
- C. Mechanical Supplies
- D. Experimental and Research Work

The *Budget Order* requires the following approvals:

$10 to $50: Department Head, Production Manager, and Plant Engineer;

$50 to $250: Works Manager in addition to above;

$250 and over: Operating Manager in addition to above;

Capital Charges: All the above signatures.

All *Budget Orders* in excess of $50 require the Comptroller's approval for classification of charges.

For a more detailed discussion of capital and expense charges see the following: *Budget Order Procedure, Property Record Procedure*

Expense Job Order Numbers run from 2000 to 2999 and repeat.

Capital Job Order Numbers run from 1000 to 1999 and repeat.

3. *Handling the Work Order*

(A) Dispatching and Scheduling the Work Order—when a *Repair Request,* in duplicate, is received by the dispatch clerk it shall be numbered and the original given to the crew foreman whose responsibility it shall be to execute the work. The duplicate copy is used by the dispatch clerk in his follow-up file. If the work involves several crews the dispatch clerk will supply the additional copies of the *Repair Request.*

If the work involved will cost in excess of $10, an estimate is made and a *Budget Order* written, the proper approvals are secured and the work is then put into process.

The dispatch clerk shall keep a follow-up and other necessary control of each *Repair Request* received.

When the work required by the *Repair Request* is completed the request is to be signed by the person who originated it, signifying his acceptance of the work. The original request shall be kept by the dispatch clerk for six months from date of completion.

(B) *Ordering Materials*—upon receiving approval to proceed with a work order, each foreman is responsible for securing the materials he will require before the date needed.

Materials carried in the Mechanical Storeroom may be secured by the use of a *Stores Issue* ticket.

Materials from the outside are ordered by the use of a *Requisition* approved as follows:

Up to $50: Plant Engineer;

$50 to $250: Works Manager in addition to above;

$250 and over: Operating Manager in addition to above.

(C) *Completing a Work Order*—it shall be the responsibility of the supervising foreman or mechanic to inspect each job to determine that all required work has been completed in a workmanlike manner, that all tools and debris have been removed, and that all patching and painting of surfaces where needed have been finished.

The final acceptance of a job by the requisitioner shall release the Mechanical Department of any further responsibility.

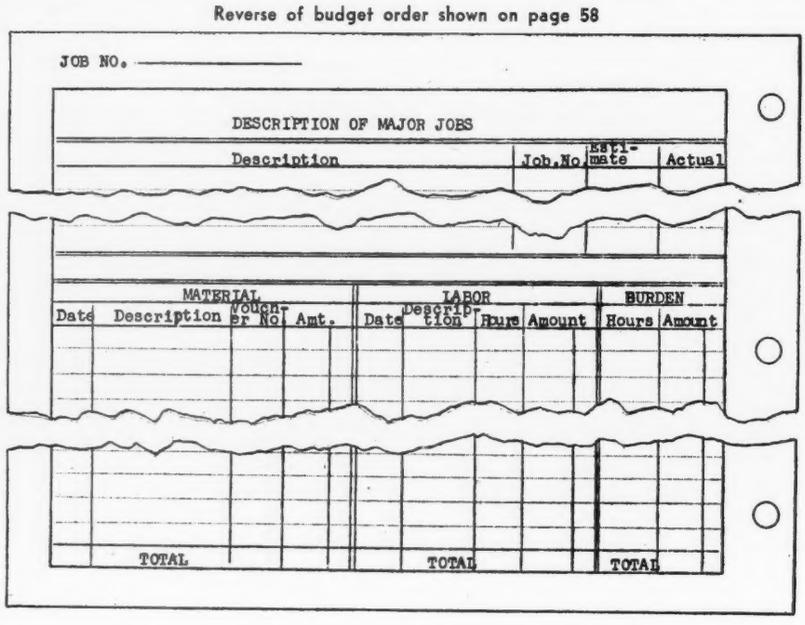
(D) *Methods of Caring for Labor Charges*—the labor charges against each job shall be collected daily upon the *Daily Time Report* of each mechanic. The workman shall be responsible for the proper posting of pertinent data.

The first work day of each week the *Daily Time Reports* shall be collected by each supervisor who shall satisfy himself as to their correctness. The *Daily Time Report* sheets will then be given to the Dispatch Clerk.

The Accounting Department will post their copy of the budget order direct from the *Daily Time Report* sheets. The material items are posted direct from the *Stores Issue* sheets.

(E) *Inspections and Detailed Functions*—for specific inspections and detailed functions see the separate procedures covering these operations.

Reverse of budget order shown on page 58



When Motor Starters Go Bad

Here are ways in which maintenance can get the wheels turning and keep management happy while repairs are being made

JAMES DIXON
Construction Engineer
Crocker-Wheeler Electric Manufacturing Company, Ampere, N. J.

OCCASIONS arise when some means other than the regular equipment must be quickly provided for starting a motor. In such emergencies results must be produced without delay. Efficiency in the use of power and the finer points that are important in permanent control installations become of small moment. Operators must be protected from injury, however, and so far as possible apparatus must not be subjected to abnormal stresses. It will be assumed that all necessary precautions against shocks, fire, and short circuits will be taken in erecting and handling the emergency equipment described below.

Any modern squirrel-cage motor and almost any old one that is not a cripple will stand starting by connecting it directly across full line voltage. The first inrush of current will be heavy, causing the line voltage to drop and lamps to blink. Line breakers or fuses that might open on the heavy current must be shunted with temporary jumpers that are removed after the start.

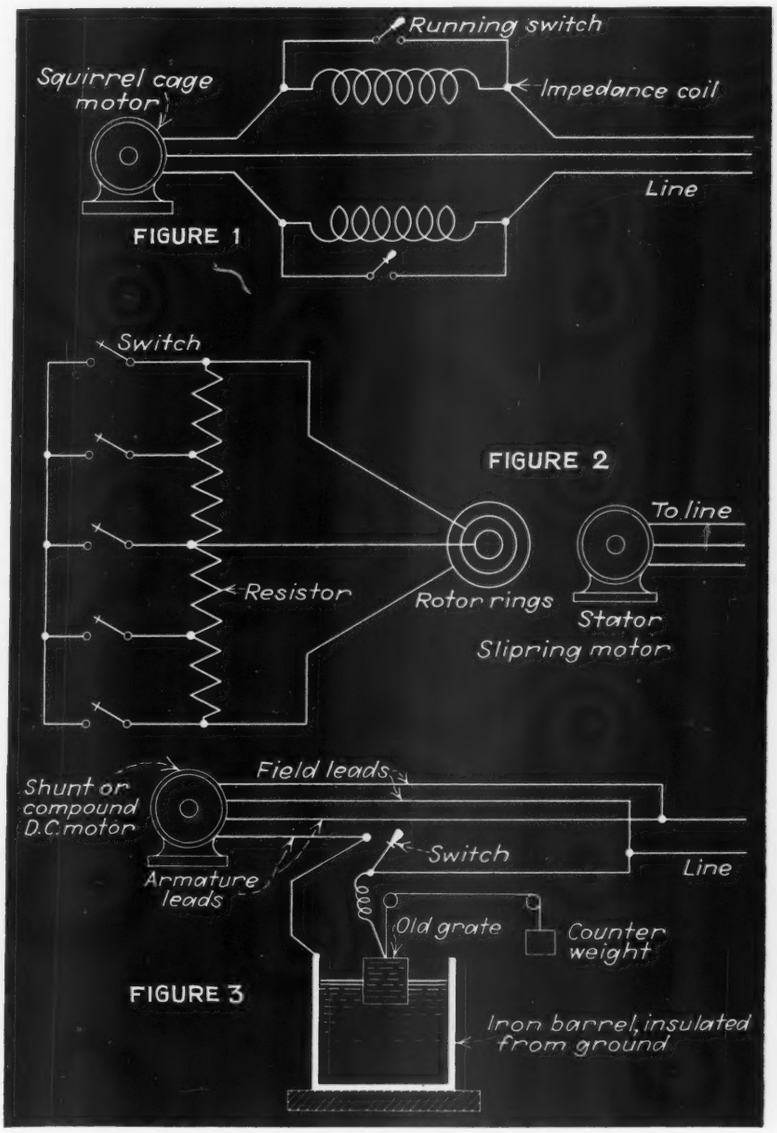
Choke Coils for Reduced Voltage

Motors as large as 1,250 hp. operating at 2,300 volts are regularly started in large plants by throwing them on the line, using switching arrangements that temporarily lock out the overload protective devices. If the effect of the heavy starting current is objectionable, however, or if the load is such that the sudden application of full power would cause damage, a substitute starter must be made.

A common expedient is to use two home-made impedances or choke coils, commonly called "hedgehogs," one in each of two line wires of a three-phase motor.

These impedances can be made of any available insulated wire large enough to carry the rated current of the motor, wound on cores made of bundles of bolts or iron rods, sheet-iron strips, or bunches of iron wire. If iron wire or strips are used, they need not be thin, since the use of fine laminations for these cores would be of no advantage.

For example, chokes to be used with a 20-hp., 220-volt motor should have cores each consisting of about fifteen ½-in. iron rods 2 ft. long, wound with about 40 turns of No. 8 rubber-covered wire. These chokes will hold the starting current down to a reasonable value, but at the same time provide power enough to start full load in 10 to 15 sec. As shown in Figure 1, switches should be installed to short circuit the



chokes and put the motor directly on the line after it is up to speed.

Slipring motors are normally started by connecting the stator to the line. Provision must be made for this connection and an emergency resistor built for the rotor circuit. This resistor can be made by wrapping iron fence wire or bale wire on a wooden frame, spacing the turns an inch or so apart for cooling. A tap from the middle of the resistor is connected to one rotor ring, and the two ends are connected to the other two rings, with intermediate taps and switches for speed control, as Figure 2 shows.

Starting Synchronous Motors

The size of iron wire needed and length for each section of the resistor can be worked out from the rotor voltage and current as given on the motor nameplate, and from the table.

As will be seen from the table the carrying capacity of iron wire immersed in water is many times greater than in air, so that a shorter length and smaller diameter of wire can be used. Hence, if the resistor is immersed, it can be made quite small and neat.

Synchronous motors can be started by means similar to those described for squirrel-cage motors. They are usually much larger than the latter and the current inrush will be correspondingly greater, in spite of the fact that they are regularly started at light load or no load. The starting devices should therefore be proportioned according to the full-load current rating.

For big motors resistors are easier to make than impedances, particularly when water cooled, and will provide smooth starting.

In one instance a 400-hp., 6,600-volt, three-phase, 25-cycle synchronous motor connected through a rope drive to a pump was successfully operated with an emergency starter. The resistors were three in number, one in each phase, and were made of cast-iron water pipes, 8 ft. long and 12 in. in diameter. The pipes were lagged with wood strips and wound with No. 14 iron wire, held by staples. All three resistors were immersed in a wooden tank filled with transformer oil. This outfit replaced a burned-out auto-transformer and made more than ten starts while a new transformer was on the way.

Starting d.c. motors larger than ¼ hp. by throwing them on full line voltage is likely to damage the brush gear or commutator. This danger comes about because the shunt field is of high self-inductance and requires an appreciable time to become magnetized. Until it has done so and the armature has begun to revolve, the current is limited only by the resistance of the armature circuit, which is low.

For D.C. Motors, a Water Rheostat

To start shunt- or compound-wound d.c. motors it is necessary to provide a connection for the shunt field direct to the line and an armature connection through a current-limiting resistance which can be cut out after starting.

The most convenient device is some form of water rheostat, the material for which is easy to obtain. The tank or container can be a metal ash can or oil barrel. One terminal can be connected to this metal tank so that only one other terminal is needed. The second or movable terminal can be a metal plate hanging by one edge, an old grate bar, or a bunch of chain. A system of pulleys, rope, and counterweights should be arranged so that the movable terminal can be moved up or down at will and set at any desired point.

When lowered to the bottom, the movable terminal cuts out all the resistance. However, it is advisable to use a switch as in Figure 3 to make a good final contact and serve as the running connection.

Plain water has fairly high resistance; a handful of salt or washing soda will reduce it.

Starting Series Motors

Series motors can be started in the same way, but since they have no shunt field, that part of the wiring can be omitted.

When it is known that the emergency starter will be in use for some time, it may be worth while to construct a wire resistor with switches to cut out resistance in steps. The size and length of wire needed can be determined from the rating of the motor as given on the nameplate, and from the table.

Overload protection after starting should be provided even with temporary, makeshift starters. The simplest way of providing protection is to put a fuse or circuit breaker in two of the three lines of a three-phase circuit, or in one line of a d.c. circuit. If standard fuses or circuit breakers are available, they should be used. When absolutely necessary in an emergency, home-made link fuses can be used. The chance of trouble without some overload protection is so great that its omission is inexcusable.

Emergency Overload Protection

A fuse block for low voltage can be made from two metal strips to which the fuses and wires are attached, mounted on a block of dry hardwood. These strips should be drilled and tapped for the electrical connections, and fastened to the base with wood screws.

Materials from which fusible links can be made, and their approximate carrying capacity are:

- 6 amp., one strand No. 31 copper, out of common lamp cord
- 10 amp., two strands No. 31 twisted together loosely
- 60 amp., one strand, ⅛-in. wire solder
- 80 amp., one strand No. 18 copper wire
- 100 amp., two strands ⅛-in. wire solder set close together
- 250 amp., one strand No. 12 copper

It must be borne in mind that the use of such makeshifts is excusable only in serious emergencies. They should be discarded just as quickly as possible.

Approximate Carrying Capacity of Iron Wire In Air and Water

B & S Gage	Feet per Pound	Amperes in Air	Feet in Air	Amperes in Water*	Feet in Water*
20	369	2.5	594	36	25
18	232	3.6	673	51	29
16	146	5.1	750	72	32
14	92	7.2	840	103	36
12	58	10.1	941	145	40
10	36	14.4	1054	205	45
9	33	17.2	1103	245	47
8	25	20.4	1354	292	52

* Number of feet required to limit current to the amperes given in the preceding column, at 110 volts.

How Long to Speed Up or Slow Down?

Use these formulas when you have to calculate the time required for a load to accelerate or decelerate

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Industrial Department
General Electric Company
Schenectady, N. Y.

WHEN changes are being made in production equipment it is sometimes necessary to calculate the time required for rotating parts to accelerate or decelerate through a given range of speed. For example, it may be required to determine how long it will take some machine or group of machines in a proposed cycle of operation to come up to the proper speed at which a certain operation may be started and then, upon completion of that operation, return to the initial speed or to rest, ready for the next operation in the sequence.

If the accelerating or decelerating torque applied to the rotating machinery is constant throughout the speed range being considered, the time required to come up to speed or stop can readily be calculated by means of the formula:

$$\text{Time, in seconds} = \frac{WR^2(N_2 - N_1)}{308} \times \frac{1}{T} \quad \text{(I)}$$

where WR^2 = weight in pounds times (radius of gyration in feet)^2 of the rotating parts.
N_1 = the lower speed in revolutions per minute
N_2 = the higher speed in revolutions per minute
T = accelerating or decelerating torque in pounds-feet

In calculations involving motor-driven machines, it is convenient to express the torque in per cent of the full-load torque (corresponding to a certain horsepower and speed rating), and the formula then becomes:

$$\text{Time, in seconds} = 0.62 \times \frac{WR^2}{Hp.} \times \frac{(N_2 - N_1)}{1000} \times \frac{\text{Full-load-R.p.m.}}{1000} \times \frac{100}{\%\,T} \quad \text{(II)}$$

Although in many problems the accelerating or decelerating torque varies over the speed range involved, instead of remaining constant, the formulas given above will apply if the term $1 \div T$ is replaced by "$(1 \div T)$ average." The latter term represents the average, over the speed range considered, of the reciprocal of the torque. Thus it is necessary to calculate the reciprocal of the accelerating or decelerating torque at a sufficient number of speed points to plot a curve of this reciprocal and determine its average value. As will be shown in an example given later, there may be appreciable error in merely determining the average torque and substituting it in the formula, instead of calculating the average of the reciprocal of the torque.

Frequently the accelerating or decelerating torque varies as a straight line with the speed, over a considerable range. When it does the accelerating or decelerating time for the speed range can be calculated, using one of the formulas given above, by substituting "equivalent torque" for the torque, T. To determine the equivalent torque it is necessary merely to multiply the average torque for the speed range by a factor, K, which may be obtained by referring to Figure 1. There, the factor K is shown plotted against the ratio $(T_1 \div T_2)$, where T_1 and T_2

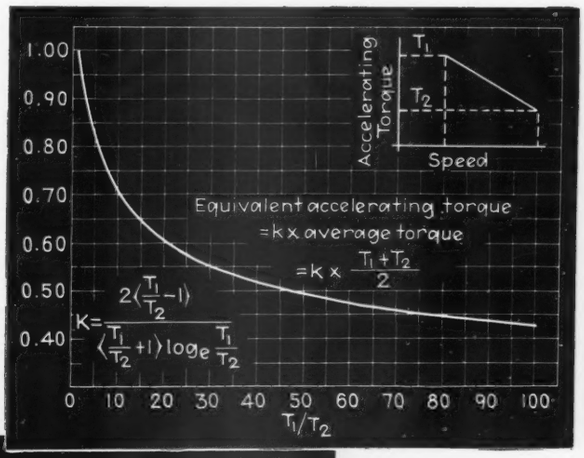


FIGURE 1 — Equivalent accelerating torque for calculating accelerating time can be determined from this curve

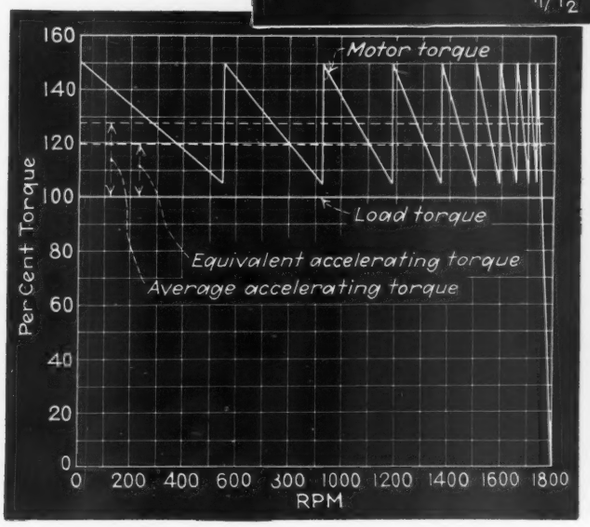
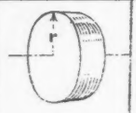
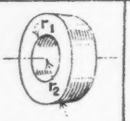
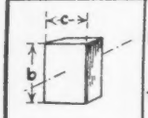
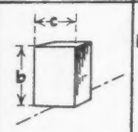
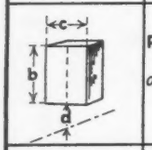
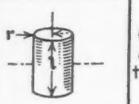
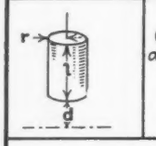
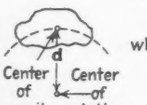


FIGURE 2 — Speed-torque curve for acceleration of a wound-rotor induction motor

TABLE I—Radii of Gyration for Rotating Bodies

	SOLID CYLINDER about its own axis	$R^2 = \frac{r^2}{2}$
	HOLLOW CYLINDER about its own axis	$R^2 = \frac{r_1^2 + r_2^2}{2}$
	RECTANGULAR PRISM about axis through center	$R^2 = \frac{b^2 + c^2}{12}$
	RECTANGULAR PRISM about axis at one end	$R^2 = \frac{4b^2 + c^2}{12}$
	RECTANGULAR PRISM about outside axis	$R^2 = \frac{4b^2 + c^2 + 12bd + 12d^2}{12}$
	CYLINDER about axis through center	$R^2 = \frac{l + 3r^2}{12}$
	CYLINDER about axis at one end	$R^2 = \frac{4l^2 + 3r^2}{12}$
	CYLINDER about outside axis	$R^2 = \frac{4l^2 + 3r^2 + 12dl + 12d^2}{12}$
	Any body about axis outside its center of gravity $R_1^2 = R_0^2 + d^2$ where R_0 = radius of gyration about axis through center of gravity R_1 = radius of gyration about any other parallel axis d = distance between center of gravity and axis of rotation	

are the highest and lowest values respectively of the accelerating or decelerating torque over the straight-line section considered.

The torque-speed curve can usually be represented with sufficient accuracy by a limited number of straight-line sections. The accelerating or decelerating time for each section can be calculated by the method given, and these times added to give the total accelerating or decelerating time.

To illustrate the method of calculation, assume that a 100-hp., 1,750-r.p.m., wound-rotor induction motor is to accelerate a constant-torque load with a total WR^2 (for motor and load) of 500 lb.-ft.^{2} Further, assume that the secondary control is designed to limit the torque peaks to 150 per cent of motor full-load torque and that the motor is allowed to accelerate on each step to a speed where the motor torque is 50 per cent greater than the load torque, as indicated in Figure 2. The average accelerating torque is $(50 + 5) \div 2 = 27.5$ per cent.

Since the ratio $T_1 \div T_2$ is $50 \div 5$ or 10 for each of the accelerating steps the factor K is seen from Figure 1 to be 0.71 and the equivalent accelerating torque is 0.71×27.5 or 19.5 per cent. This value is the same for each of the steps; therefore the total accelerating time can be calculated from Formula (II) as follows:

$$\text{Time, in seconds} = 0.62 \times \frac{500}{100} \times \left(\frac{1750 - 0}{1000}\right) \times \frac{1750}{1000} \times \frac{100}{19.5} = 48.6$$

If the average accelerating torque, 27.5 per cent, had been used directly in the formula, the calculated accelerating time would have been 34.5 seconds, representing an error of 29 per cent. Had the equivalent accelerating torque been different for each of the speed steps, it would have been necessary to calculate the accelerating time for each step and add them to obtain the total accelerating time.

In Formulas (I) and (II), it is usually a simple matter to determine the values to be substituted in the terms representing speed and torque. The term WR^2, however, is sometimes not so easily evaluated.

As stated before, WR^2 represents the weight of the rotating body multiplied by its radius of gyration squared. Since the kinetic or stored energy in the body is directly proportional to this factor, it is commonly known as "moment of inertia," although strictly speaking moment of inertia is $WR^2 \div 32.2$. However, in developing the most commonly used formulas, the factor 32.2 disappears or is absorbed in the constants, so that the term WR^2 remains as a convenient medium of calculation.

Piece by Piece

Calculation of the weight, W, is very simple. The determination of R, however, is relatively complicated. To simplify such calculations Table I gives the radii of gyration for various forms of bodies and for various axes of rotation of these bodies, as shown by the illustrations.

Practically, a rotating body will seldom correspond exactly to any one of the forms shown. In every instance, however, it may be resolved into parts, each of which agrees absolutely or very closely with one of the forms in the table. For example, a spoked flywheel can usually be separated into a rim, corresponding to Form 2; spokes, each corresponding to Form 5 or 8; and a hub

Table II—Approximations for Calculating Moments of Inertia

NAME OF PART	Moment of Inertia
Flywheels (not applicable to belt pulleys)	Moment of inertia equal to 1.08 to 1.15 times that of rim alone
Flywheel (based on total weight and outside diameter)	Moment of inertia equal to two-thirds of that of total weight concentrated at the outer circumference
Spur or helical gears (teeth alone)	Moment of inertia of teeth equal to 40 per cent of that of a hollow cylinder of the limiting dimensions
Spur or helical gears (rim alone)	Figured as a hollow cylinder of same limiting dimensions
Spur or helical gears (total moment of inertia)	Equal to 1.25 times the sum of that of teeth plus rim
Spur or helical gears (with only weight and pitch diameter known)	Moment of inertia considered equal to 0.60 times the moment of inertia of the total weight concentrated at the pitch circle
Motor armature (based on total weight and outside diameter)	Multiplying outer radius of armature by following factors to obtain radius of gyration: Large, slow-speed motor.....0.75 to 0.85 Medium-speed d.c. or induction motor .....0.70 to 0.80 Mill-type motor.....0.60 to 0.65

corresponding to Form 2. If the flywheel is webbed, the web would also correspond to Form 2.

The moment of inertia $WR^2 \div 32.2$ of the wheel will be equal to the sum of the moments of interia of all the parts as calculated separately, each revolving about the same axis of rotation, usually the center of the shaft. Each separate calculation will merely involve multiplying the weight of the part by its radius of gyration squared. In ordinary calculations the radius is always taken in feet and the weight in pounds, unless otherwise specified.

Linearly Moving Parts

In many instances it is not necessary to calculate each individual part exactly. If a flywheel has a heavy rim and is relatively large in diameter, it is usually sufficient to calculate the rim and then add a percentage for the spokes and hub, since they are lighter and are nearer the center and hence have a lower R. In the case of motor armatures, calculations without actual design data are usually based only on the weight and outside diameter. Table II shows average values for R which are suitable for approximate calculations.

Thus far the term WR^2 has pertained to a machine element with respect to the axis about which it is rotating. As a rule, however, most problems involve several machine elements running at various speeds different from that of the motor driving them. In order to calculate acceleration time for a system with various parts running at different speeds, it is necessary to reduce all the components entering into it to a common base.

This is done by finding the "equivalent WR^2" of each element with reference to some common base which for convenience may be taken as the motor shaft when accelerating time is being calculated, or as the brake shaft when decelerating time is wanted. In any case the equivalent WR^2 of a part running at a speed different from that of the base speed is equal to the WR^2 of that part multiplied by the square of the ratio of its speed to that of the base speed, as expressed by the equation:

$$\text{Equivalent } WR^2 = WR^2 \times \left(\frac{N}{N_b}\right)^2 \qquad \text{(III)}$$

where N is the speed of the part and N_b is the base speed

The above discussion has dealt with rotating parts exclusively. Many problems involve a combination of rotating parts and linearly moving parts. Therefore, to determine the accelerating torque for such combinations it is necessary to reduce the mathematical consideration of the linearly moving parts to a basis equivalent to that used for the rotating parts — consideration of the latter generally being based on the speed at the motor shaft.

The linear speed of a concentrated mass at radius R feet is $2\pi RN$ feet per minute, where N is expressed in r.p.m. Then the energy is $\frac{1}{2}M(2\pi RN)^2$ for the rotating body and $\frac{1}{2}MV^2$ for the linearly moving body. Equating these two expressions and substituting $W \div 32.2$ for M to obtain pounds, gives:

$$WR^2 (2\pi N)^2 = WV^2, \text{ and by transposing}$$

$$WR^2 \text{ (equiv.)} = W\left(\frac{V}{2\pi N}\right)^2 \qquad \text{(IV)}$$

In this case the expression WR^2 represents the inertia of the linearly moving parts reduced to a basis equivalent to that of the rotating parts. It is obtained by multiplying the weight, in pounds, of the part by the square of the ratio between the velocity in feet per minute of the part and 2π times the base speed in revolutions per minute.

It must be noted, however, that Equation (IV) is valid only when the velocity V bears a *constant* relation to the base speed N_b, as in the case of a rack engaged with a pinion on the motor shaft. For reciprocating parts, conversely, Equation (IV) cannot be directly applied, because such parts have a varying velocity that attains a maximum in one direction, retards to zero, and then attains a maximum again in the opposite direction, while the motor is running at constant speed. In such cases, obviously, more complex mathematical considerations, beyond the scope of this discussion, are necessary in order to apply the principle of Equation (IV).

One Speed for All

Nevertheless, by the use of Equations (III) and (IV) the calculations on all parts of a system that either rotate or move linearly can be reduced to the mathematical basis corresponding to the speed of the driving motor or to any other reference speed. After the summation of the equivalent WR^2 of all parts has been made, the time required to accelerate or decelerate can be calculated from Equation (I) or Equation (II). In those equations, the terms N_1 and N_2 are, of course, the limits between which the base speed N_b is varied during acceleration or deceleration.

Readers Want Answers

You are invited to submit answers to these questions out of your own experience

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Stripping Portable Tool Armatures

I should like to know the procedure followed by other readers in stripping high-speed, portable tool armatures for rewinding. What is the best way of softening the insulating varnish prior to removing the coils? —*C.E.C.*

How Stop Leakage Through Concrete Wall?

A good deal of trouble is being experienced from leakage of a concrete wall which is part of a mill race. It appears that sections of the wall which were poured at different times did not bond properly, or that voids were left, through which an objectionable amount of water seeps into our mill. Will someone please tell me the best way of correcting this condition? —*L.C.*

Windings for Solenoid Brakes

Can any reader tell me why some electric solenoid brake coils are wound with two sizes of wire, such as No. 19 and No. 23, the two windings being permanently connected in series? —*B.C.*

Answers to previous questions are found on page 68

Operating Shorts

Time Meters Used in Finding Refrigerating Costs

RAY B. WOLF
San Francisco

In distributing operating costs there are occasions where the use of time meters is very helpful. This is particularly true when one machine is used to perform various services, either simultaneously or alternately, and a check is desired for each operation. How such a check was provided for a refrigerating system in a dairy plant, where one unit takes care of the cooling of two rooms, is shown in the wiring diagram.

Room *A* is a basic part of the production end of this installation, whereas Room *B* is incidental to plant production, being used for storage of a product that is not made at this plant. Accurate operating costs were desired for both rooms, so that the correct charges could be levied against each. Time meters with minute registers were connected as shown. These meters register in minutes the actual operating time of the unit and also of the magnetic valves controlling the flow of refrigerant to each room. The valves are actuated by room thermostats and are electrically opened whenever refrigeration is required. Readings of the meters are taken regularly on the first of the month, and changed into hours by dividing by 60.

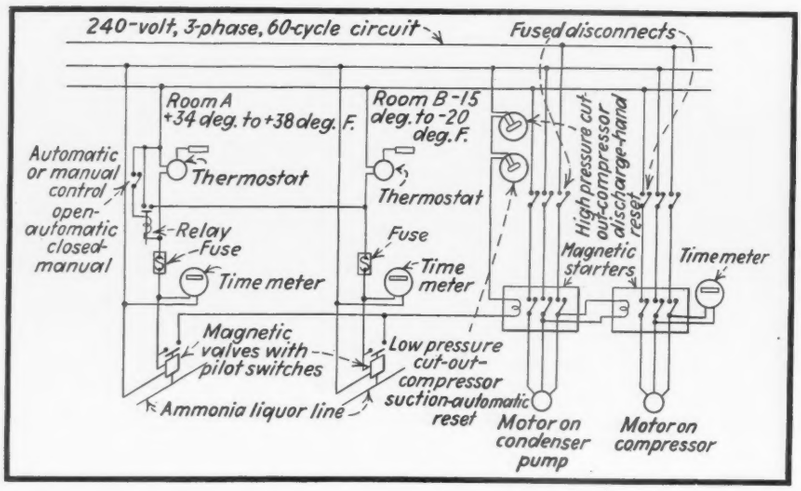
The combined total hours of operation for both rooms is usually greater than the total hours of operation of the refrigerating unit, because both rooms sometimes need refrigeration at the same time. Or, one room may become sufficiently cooled and the refrigerant valve be closed, before the other room cools down.

The cost of operating the refrigerating unit is found by multiplying the total hours per month by the hourly charge. The kilowatt-hours per hour consumption of the unit was determined by taking readings on the two motors over a long period of time, at the average operating pressures.

The operating cost for Room *A* is found by multiplying the hours of refrigeration demand by the hourly charge for the unit. The charge for Room *B* is determined by subtracting the charge against Room *A* from the total operating cost of the unit. An example from our records will show the results and how they are obtained. The power consumption of the unit is 21 kw.-hr. per hour. Cost of power averages 1.5 cents per kilowatt-hour.

Reading of compressor meter for month, hours.....	540
Room *A* time meter, hours...	360
Room *B* time meter, hours...	210
Total operating cost (540 × 21 × $0.015).....	$170.10
Cost for Room *A* (360 × 21 × $0.015)	$113.40
Cost for Room *B* ($170.10 minus $113.40)	$56.70

Mr. Wolf's contribution has been awarded the $10 *payment offered by the editors for the best Operating Short submitted during the past month.*



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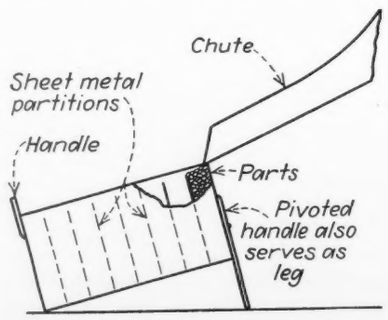
A variable-speed transmission plus a variable speed pulley on the motor drive shaft is one way of achieving wide-range speed control.

•

Box Reduces Mixing of Good Work with Bad

F. MUIR, *Hamilton, Ont.*

After repairing or setting an automatic machine, the work coming off must be watched for a time to check the accuracy of the adjustments. If an ordinary box or pan is placed beneath the chute and the machine suddenly begins to turn out defective parts, they will be mixed up with the good work in the box and a good deal of time may be required to separate them.



The compartment box shown will avoid mixing up good and defective parts that roll or slide easily. It is divided into suitable compartments by means of sheet-metal partitions. As each compartment becomes full, additional parts overflow into the next one.

One handle is pivoted so that it

can be turned up and used when carrying the box, or swung down to form a leg to hold the box at an angle beneath the chute. One compartment of the box fills up at a time and any defective work is isolated in one or two compartments, at the most, if the work is inspected regularly.

In a polishing room operators were turning out 85 per cent of assigned production. Lighting was increased from 16 to 35 foot-candles. Now production is 120 per cent of schedule.

Pneumatic-Tired Trucks Make Easy Handling

SOURCE, *R. G. Le Tourneau, Inc. Stockton, Calif.*

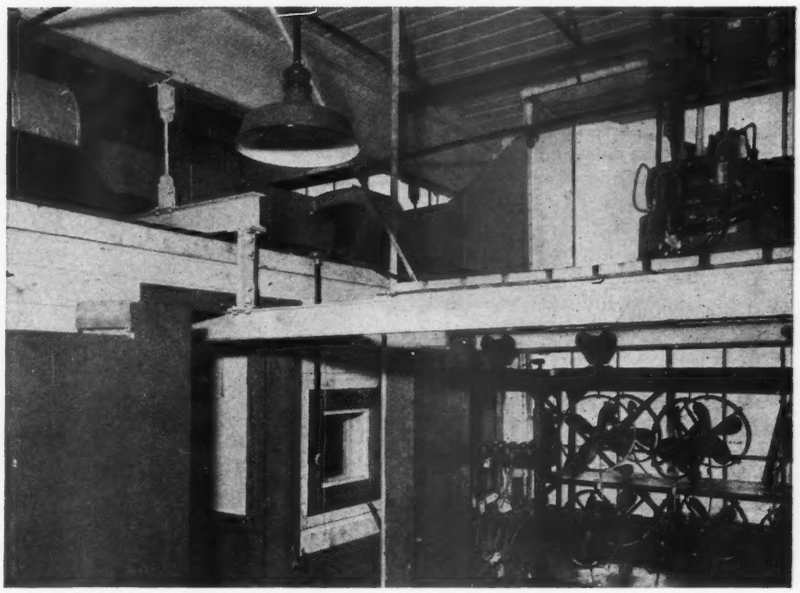
Two home-made, pneumatic-tired hand trucks have proved to be immensely valuable in our intra-plant transportation. One is a one-wheel, wheelbarrow-like unit while the other is a three-wheel flat truck.

Main feature of both trucks is the use of pneumatic tires, which makes it possible to move heavy loads over rough ground and minor obstructions.

Dimensions of the wheelbarrow are width 30 in., length 24 in., height above ground 9 in. The carrying platform is 2 in. deep to prevent loads from sliding off. Tire used is an air wheel of convenient size.

The three-wheel flat truck is 60 in. long, 36 in. wide, and its platform is 19 in. above the ground. The platform is 3 in. deep, and there are three 7.00x4 tires.

With these trucks one man can move loads of considerable weight and bulk.



Better Tests with Air Conditioned Test Booths

SOURCE, *Westinghouse Electric & Manufacturing Company East Springfield, Mass.*

Air conditioned, soundproof testing rooms for testing electrical appliances assure more accurate tests and provide more comfortable working conditions for operators.

The final test is one of the most important operations on an electrical appliance. It is made to insure quietness of operation, high mechanical and high electrical efficiency. While making it, it is desirable to eliminate outside interference.

A central conditioner and distributing duct system provide a continuous flow of air of controlled temperature to several test booths. The duct is lined with sound-absorbing material and is connected to the test booths by means of canvas connectors. All air may be recirculated, or some recirculated with fresh air added.

Operators have been found to be more alert and better able to conduct the tests since the installation has been made.

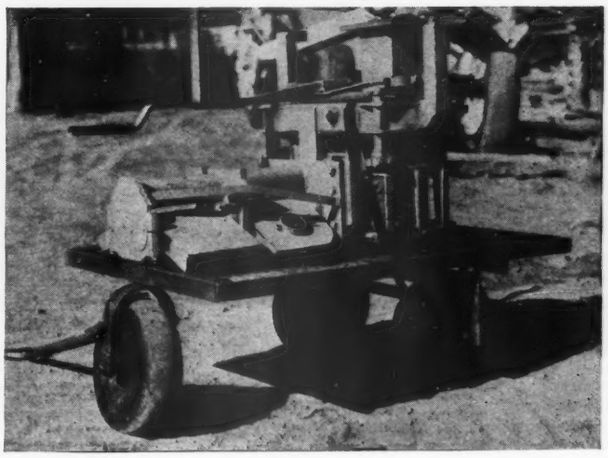
•

Detector for Broken Needles in Rugs and Carpets

SOURCE, *General Electric Company Schenectady, N. Y.*

A device which locates broken needles was recently developed for a rug and carpet manufacturer. In spite of all precautions the needles used in making rugs and carpets sometimes break and become deeply imbedded in the finished product. With the new device, the presence and exact location of the steel barb can be ascertained by passing the carpet twice through a frame.

It consists of a test coil, motor-



generator set, and amplifier. Power is supplied by the motor-generator set at 2160 cycles to the test coil, which has two primary and two secondary windings. The secondary windings of the test coil are connected differentially, or opposed. This circuit is balanced before an inspection run. The carpet or rug passes through a narrow slit, going through first one set of primary and secondary windings and then the other.

Passage of a broken needle distorts the magnetic field and produces an unbalanced voltage in the secondary circuit. This unbalance is amplified by the resistance-coupled amplifier in the secondary circuit and causes a relay to open and operate signal lights. Lengthwise and transverse passes of the rug or carpet are all that are necessary to detect the needle along two lines which intersect and give its exact location.

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Special Notice

$10 will be paid for the best Operating Short submitted during the month of February. The Editors are the judges. Other Shorts accepted will be paid for at attractive rates

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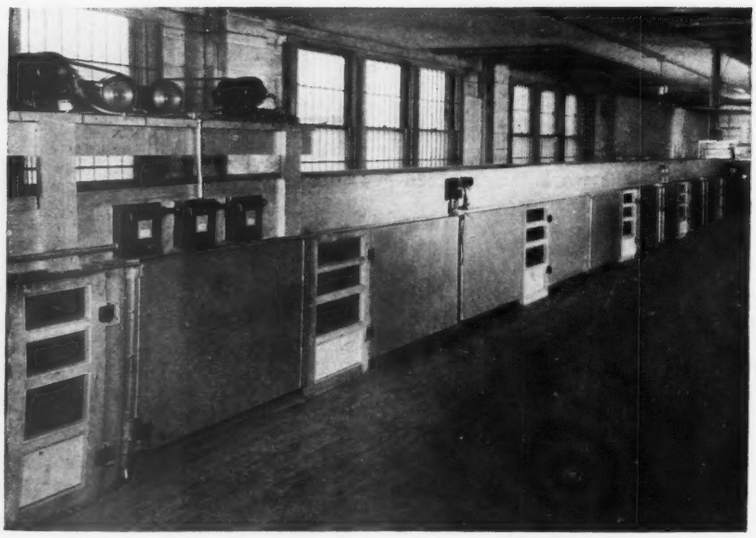
Conditioned Air Makes Better Welding Electrodes

One of the last operations in the manufacture of coated electrodes for arc welding is the application of a material which serves as a flux and as a protective covering. It is important at this point in the process that the temperature and humidity be accurately controlled. To maintain the proper atmospheric conditions for his processes and products, one manufacturer has installed an air conditioning plant.

The freshly coated electrodes are carried into a separate, closed drying room on a belt conveyor, and then through an electric oven approximately 60 ft. in length, with thermostatic control of the different heating unit zones. Moisture required for baking is provided by an automatic, spray-type humidifier which delivers conditioned air into the room rather than directly into the oven, shown in the illustration.



Answers to Readers' Questions

How Locate Grounds in Distribution System?

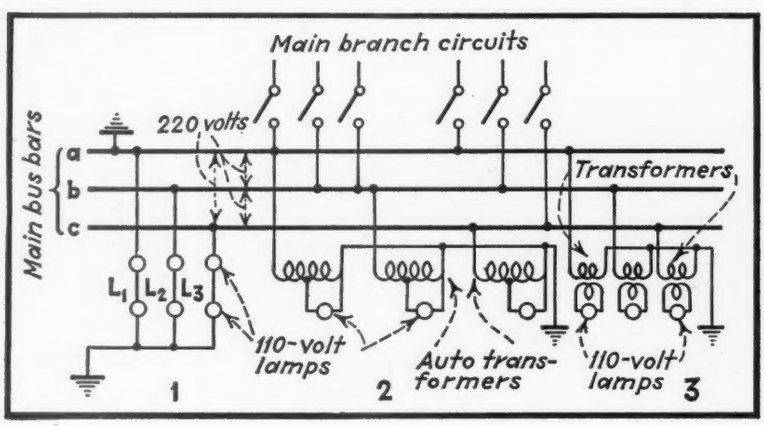
We distribute power over a three-phase, 60-cycle, 220-volt system. Recently a temporary disconnecting switch was put in one of the feeders while changes were being made. With this switch open so that no current was flowing, although the lines were hot up to the switch, a spark was noticed when one of the lugs connecting another switch farther back on the line was disconnected. No spark was obtained when the other two lugs were disconnected. Using a voltmeter I found that a voltage exists between two lines and a junction box, but none between the third wire and the box. So far no trouble has been experienced with any of our equipment.

What is the quickest way of locating such grounds? Is it necessary to use an insulation resistance meter, or will some other kind of testing equipment be satisfactory? —*M.W.B.*

THE FIRST step is to install a ground detector on the main busbars. It may consist of (1) three groups of 110-volt lamps; (2) three 220-volt autotransformers with the middle point brought out; (3) three two-winding transformers rated 220/110 volts. Connections are shown in the diagrams.

A ground on any conductor will be indicated by one of the lamps. Normally all of the lamps burn dimly. When one line becomes grounded the voltage of the others is raised to

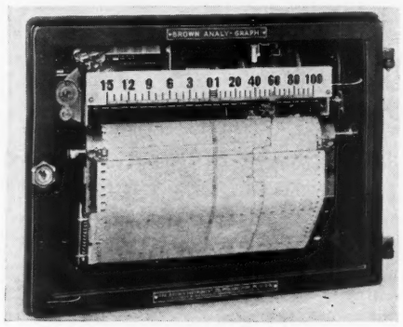
(Continued on page 110)



What's NEW in Equipment

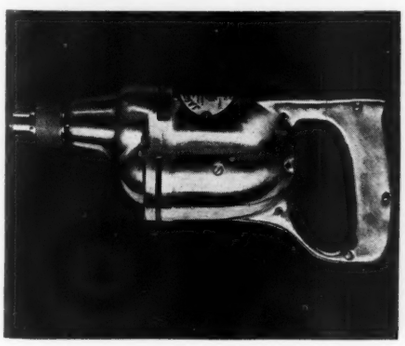
Combustion Analyzer

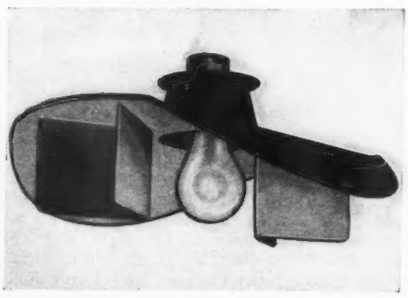
Furnace atmosphere "Analy-Graph" operates on principle of measuring thermal conductivity of combustion gas mixture. When complete combustion takes place, conductivity is less than 1.00, due to presence of CO_2; if gas is the result of incomplete combustion or dissociation, conductivity is nearly always greater than 1.00. Chart on recording instrument is divided into two equal sections to show the two different conditions. This recording instrument is of potentiometer type, with specially graduated 12-in. wide chart. Applicable to both electric and fuel-fired furnaces, this instrument is designed for use in heat-treating installations. The Brown Instrument Co., Philadelphia.



Drill

Jasco Junior electric drill is powerful, light duty type, weighing 3 3/4 lb., and having overall length of 10 1/2 in. Universal motor is fan-cooled. Armature bearings are of graphite impregnated bronze; spindle revolves in grease-lubricated bronze bushing and has oversize ball thrust bearing. Free speed is 2,000 r.p.m. Frame, gear plate, and gear head are cast aluminum alloy. Jas. Clark, Jr., Electric Co., Louisville, Ky.





Bin Lighting Unit

Concentrates light to vertical and horizontal surfaces of bins and stacks. Consists of socket and reflector with socket cover. Uses standard 60-, 75-, or 100-watt inside-frosted lamps. Westinghouse Electric & Mfg. Co., East Pittsburgh.

Work Bench

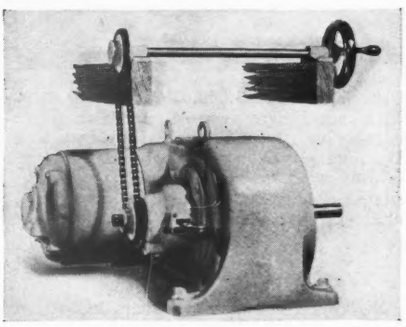
Steel work bench has top made of 10- or 12-gage metal and four legs made of channels. Legs are braced at the rear and there is steel shelf fitted to them. Lengths 6-10 ft. are available. Drawers and vise blocks can be attached by means of holes punched in top plate. Height 34 in., depth 28 in. Suited to heavy repair work. Lyon Metal Products, Inc., Aurora, Ill.

Voltage Regulator

Improved voltage regulator, "Type TH Transtat," is available in standard sizes for controlling voltage to loads up to 2.5 kva., on 115- or 230-volt lines. Smooth, continuous control from practically zero to normal line potential is achieved in increments of the order of 0.5 volt. It is said that maximum rated amperage is obtainable at any setting, that output can be stepped up to values higher than line voltage, that equipment has no effect upon power factor. Consists of transformer coil surrounding an annular steel core and a carbon brush which may be rotated in continuous contact with commutator encircling the core. Designed primarily for service on single-phase circuits of low voltage, but can be adapted by various methods for regulating higher voltages and controlling polyphase circuits. The regulator lends itself as a control of voltage, illumination, voltage speed, or heat. American Transformer Co., 178 Emmet St., Newark, N. J.

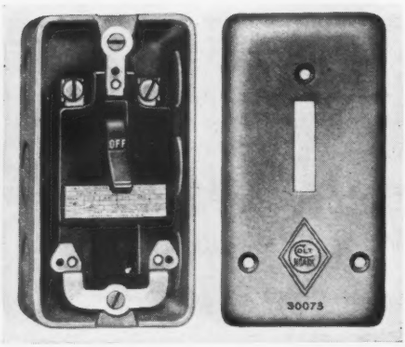
Speed Control

Line of standardized parts for obtaining remote mechanical control of variable speed has been developed for use with company's "Varidrive" motor. Speed control is positive, as there is no slippage in control mechanism. Infinite speed variation within speed range of the motor. Bearing supports, shafting, sprockets, and chains have been standarized. U. S. Electrical Motors, Inc., 200 East Slauson Ave., Los Angeles.



Circuit Breaker

This compact auxiliary circuit breaker, the "Yoke Mounted Protectit," is designed for mounting in standard metal wall boxes, as well as in special metal cabinets for surface mounting. Two types: a fixed-capacity device with 10 differently rated sizes, and an interchangeable heater element type for which there are 20 heater elements of



different ratings. Both types have maximum rating of 250 volts a.c. or d.c., and 1 hp. Colt's Patent Fire Arms Mfg. Co., Hartford, Conn.

Ammeters

Line of Dual Range "Clip-On" ammeters. Available in four low range and three high range combinations. These are 0-10/50, 0-15/75, 0-20/100, 0-50/250,

0-100/500, 0-100/1,000, 0-200/1,000 amp. With these, currents 1/5 to 1,000 amp. can be measured. Supplied with fully insulated clips and plastic handles so that they can be used with safety on insulated or uninsulated conductors. Ferranti Electric Inc., 30 Rockefeller Plaza, New York.

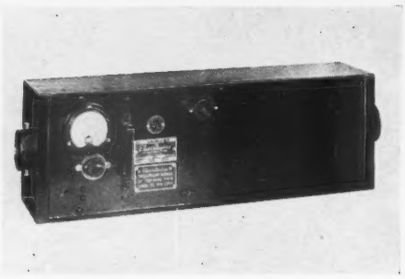
Metal Cleaners

New series of metal cleaners known as "Houghto-Clean, 100 Series." Made of 9 compounds covering light, medium, and heavy duty cleaning. Said to do rapid cleaning job where alkaline cleaner is required, removing all kinds of oils and greases. Adaptable to tank, high-pressure washing, steam gun, electrolytic and other cleaning operations. Said to be free rinsing, and efficient at low temperatures. E. F. Houghton & Co., 240 West Somerset St., Philadelphia.

Reflector

"Dynax" reflectors give a light of daylight quality using standard Mazda lamps, it is said. Shade holder and conduit mounting types in vertical and angle forms. Finish consists of three baked coatings of enamel applied over a steel frame. Dynax Reflector Co., Inc., St. Louis.

Ozone Generator



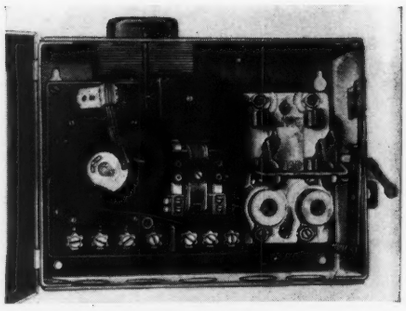
Model JR ozone unit can be attached to any air duct to supply ozone to the air going into a single room or section of a building. Air enters at the right end of the unit, is discharged at the left with ozone added. Has rheostat and meter for regulated ozone generation. Three sizes: 3,000, 4,000, and 5,000 cu.ft. per min. Electroaire Corp., 1455 West Congress St., Chicago.

Floodlight

"Lumar" floodlight has "Lumax" aluminum-reflector surface, spike or round base, cadmium-plated, heavy-gage steel base and yoke, adjustable reflector head. It is 1 ft. high, uses 200-watt lamp. Curtis Lighting, Inc., Chicago.

Overshoe

Built with non-slip sole and heel, the "Safety Work Shoe" is for use where floors are wet and slippery. Will not slip on oily or soapy floors, it is said. Available in sizes 6—12. Industrial Products Co., North 8th St., Philadelphia.



Combustion Control

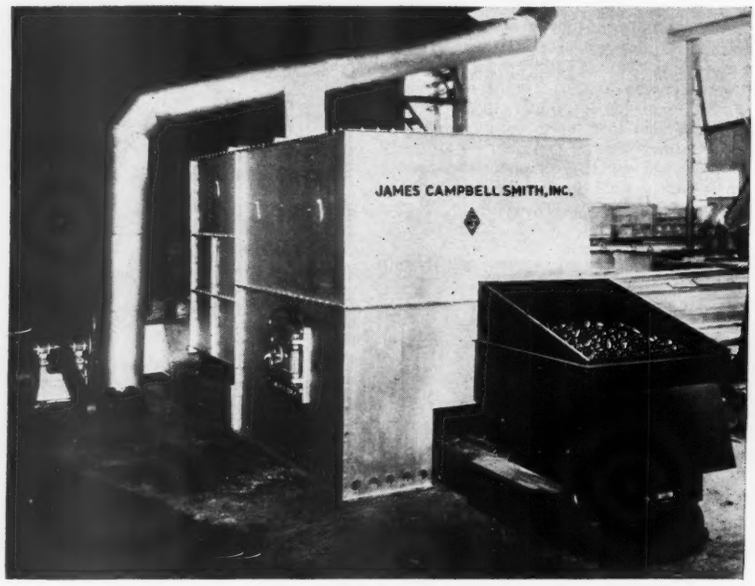
Has trip-free bimetallic overload protective unit, built-in knife switch and fuse receptacle, standard synchronous electric timer, pilot relay, and transformer for supplying low-voltage current to thermostat circuit. Overload unit has button reset. Rated up to ½ hp., 110 volts, 50 or 60 cycles. Available for ½ hp., 220-volt service, and for odd-cycle service in 110 or 220 volts. Thermostat circuit operates on 25 volts. Penn Electric Switch Co., Des Moines, Iowa.

Cleaning Brush

Cotton placed between the bristles of this brush is said to hold water or cleaning solution and prevent its dripping from the brush. Can be used for cleaning walls and ceilings and for removing calcimine. Nielco Products Co., Cicotte Ave., Detroit.

Air Heater

Automatic, indirect, coal-fired industrial air heater for use with ovens or for space heating. Adaptable to both summer and winter air conditioning, since it is said that it can be used to warm, filter, humidify, dehumidify, and refrigerate the air. Consists of a combustion chamber to which coal is fed automatically by a worm-feed stoker on automatic control, and a heat interchanger where air to be treated flows counter to combustion gases. Construction of furnace is said to make possible almost perfect combustion. James Campbell Smith, Inc., 16374 Euclid Ave., Cleveland.

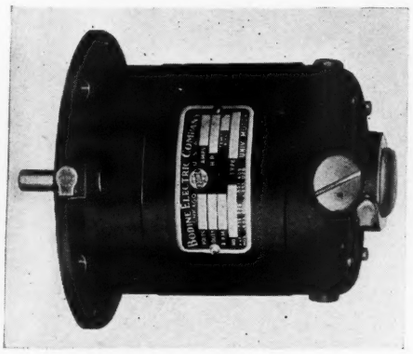


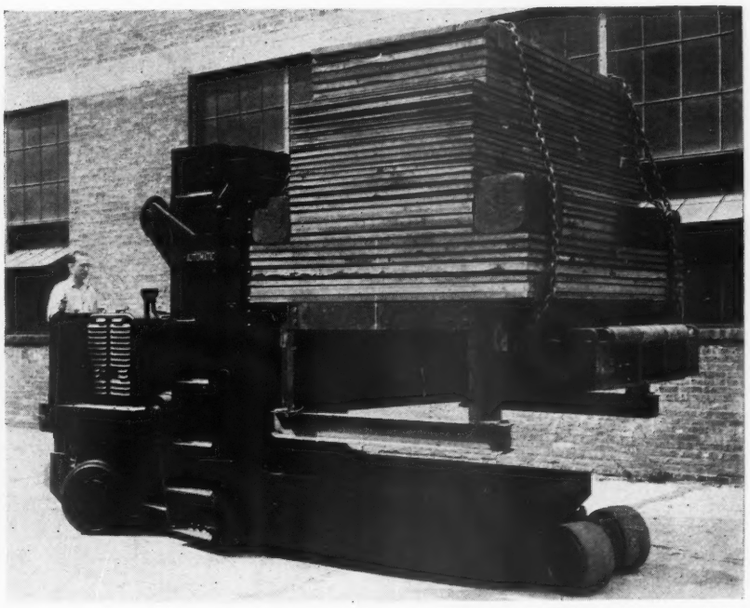
CO_2 Indicator

Line of portable "Ranarex" instruments for determining CO_2 content of flue gases and air-fuel ratio in internal combustion engine exhaust gases. Employs mechanical principle based on fact that specific weight of gases changes with air-fuel ratio or CO_2 content. A motor-driven fan revolving in a chamber blows gas against impulse wheel, producing torque on impulse wheel shaft in proportion to CO_2 content. Changes in fan speed, temperature, humidity, and atmospheric pressure are compensated for by second unit where air is blown on second impulse wheel. The two units are coupled by a balancing linkage, actuating the indicator. For use with internal combustion engines a vacuum or combined vacuum-pressure gage is built into the instrument to permit measurement of the pressure in the intake manifold. Can be furnished to operate either on lighting circuit or on 6-volt batteries. The Permutit Co., 330 West 42nd St., New York.

Motor Mounting

Flange mounting for small motors makes it possible to mount motor either horizontally or vertically with shaft perpendicular to mounting surface. Can be adapted to either ball or sleeve bearing motors. On face of flange is groove machined to close tolerances to assure accurate location and tight fit. Bodine Electric Co., 2264 West Ohio St., Chicago.



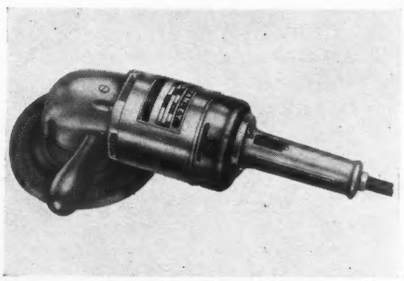


Truck

Model TLN-30 is claimed to be the world's largest capacity tiering platform truck, for it can handle loads up to 30 tons. Designed primarily for handling large dies to and from presses and storage, its dual platform lift units are synchronized for lifting loads on platforms by means of four 2-part roller chains. Has V-joint universal for driving wheel connections, and an 8-wheel trailing axle controlled by power steer. Automatic Transportation Co., 101 West 87th St., Chicago.

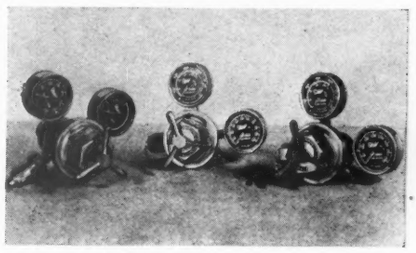
Sander

No. 77 electric disk sander for production and repair work is ball-bearing equipped throughout, sturdily constructed, light in weight, designed for use in close places. Has high-speed universal motor inclosed in aluminum alloy housing. Furnished with 7-in. flexible pad, 12 sanding disks (6 for metal and 6 for wood), wrenches and rubber-covered, 3-conductor cable. Stanley Electric Tool Division, The Stanley Works, New Britain, Conn.



Welding Regulators

Three regulators for accurate oxygen and acetylene control. All three are of same basic design, two-stage construction. Type R-64 oxygen regulator is for welding and cutting operations requiring oxygen pressures up to 75 lb. per sq. in. Type R-65 oxygen regulator is for heavy cutting operations requiring pressures up to 200 lb. per sq. in. Type R-66 acetylene regulator is a companion piece for either of the oxygen regulators. On all three, valves are stem-operated and close with incoming pressure. Point of pressure-adjusting screw is cradled in three ball bearings to preserve exact alignment. Bodies are lacquer finished, green for oxygen, red for acetylene. Pressure gages are colored and have silvered calibrations. The Linde Air Products Co., 30 East 42nd St., New York.

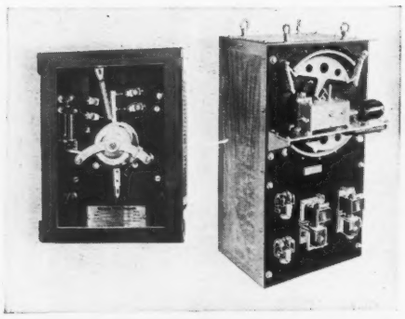


Fan

Eight-blade "Marvel" ventilating fan comes in 18—48 in. sizes. It revolves inside a mounting ring and is V-belt connected to a motor mounted in the rear. Capacities range 3,100–18,500 cu. ft. per min., and motor sizes range 1/6–¾ hp. Low-speed air delivery and quiet operation are claimed. Electric Blower Co., 352 Atlantic Ave., Boston.

Voltage Regulator

Type "J" rocking-contact rheostatic voltage regulators are designed for control of large synchronous machines where high speed of voltage recovery and accurate voltage control are essential. In modified form they can be used to control d.c. generators. Two main parts are the voltage control element and the rocking contact, motor-operated rheostat with high-speed contactors and relays. Voltage control element operates its contacts when voltage differs from normal value. Rheostat varies the machine field current and adjusts it



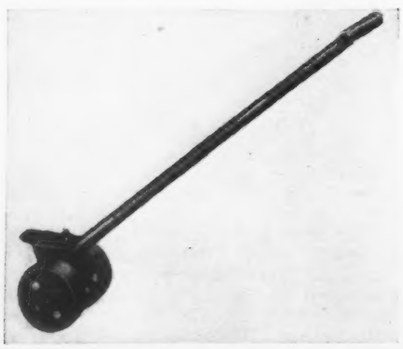
to correct value. Regulator remains at a standstill so long as voltage of the synchronous machine is normal. Allis-Chalmers Mfg. Co., Milwaukee.

Condensers

Hermetically sealed condensers are impregnated and filled with Dykanol. Inclosed in non-corrosive containers of several sizes and shapes. Can be manufactured to individual specifications. Cornell-Dubilier Corp., South Plainfield, N. J.

Jack

"EWC Load Skidder" is a draw-jack that can be placed under front of platform having two rear wheels and two front skids to move the platform. Jack



has two 7-in. diameter steel wheels with roller bearings. Wheels can be furnished with tires. The lifting pin is mounted on jack with wide bearing plate for turning. Platforms of welded construction can be supplied in variety of sizes. Platform height above floor is 10½ in.; platform wheels are 9 in. in diameter. Electric Wheel Co., Quincy, Ill.

Lighting Fixture

Design 5090 lighting fixture is suitable for office and drafting room lighting. It is equipped with a silver-mirrored X-ray reflector and gives shadowless, high-intensity illumination. Employs a 500- or 300-watt inside-frosted lamp, and has a bronze aluminum finish. Bowl is 19 1/2 in. in diameter, is 7 in. deep. Stem suspension is 36 in., but hanger may be shortened without additional theading. Curtis Lighting, Inc., 1123 West Jackson Blvd., Chicago.

Trailer

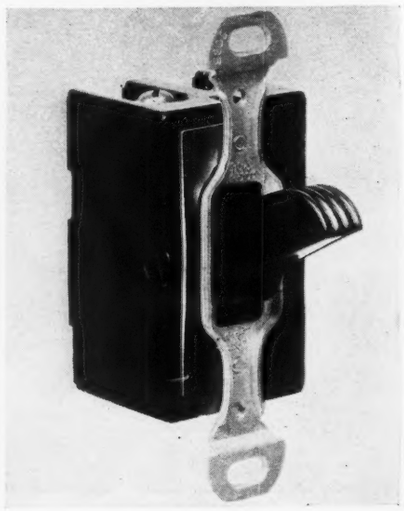
Model A-310-119-M skid-carrying trailer is designed to link together the lift-truck-skid and tractor-trailer systems of materials handling. The corrugated box skid with cut-away supports can be picked up at either end or side by the truck and deposited on the supporting steel plate bolsters of the trailer. The truck can lower the skid onto the trailer from either side or from the rear end. Trailer is of caster-steer type with steel channel frame. Wheels are rubber-tired. Running gear is protected by heavy plate guards. Trailer overall dimensions are 38 in. wide, 66 in. long (excluding coupler), 22 in. high. It accommodates box skid 66 in. long, 40 in. wide, 24 in. deep. Trailer capacity is 2-3 tons. Mercury Mfg. Co., 4110 South Halsted St., Chicago.

Protective Coating

"Firit" comes in powder form to be mixed with water and applied to metal or refractory surfaces which it will protect in temperatures up to 3,600 deg. F. Applicable to stirrers, tongs, furnace walls, linings. Foundry Service, Inc., 107 East 41st St., New York, N. Y.

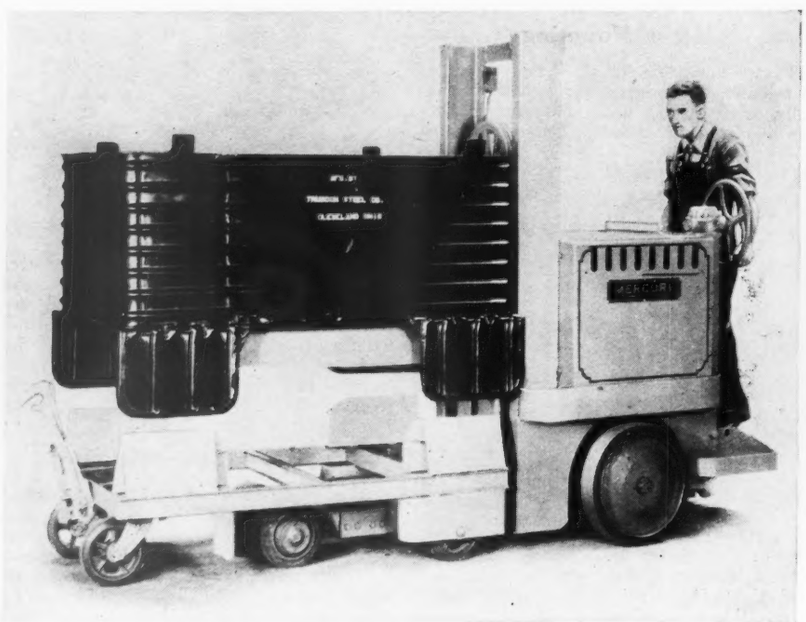
Toggle Switch

For use on equipment using fractional-horsepower a.c. motors where overload protection is not required. Made with two or three positions for interior or exterior mounting. Slow-breaking, heavy silver contacts. Rated 20 amp., 250 volts, or 1 hp., 250 volts. The Hart Mfg. Co., Hartford, Conn.



Electrode

It is claimed that welds with tensile strength of 100,000 lb. per sq. in. can be made with the "Shield-Arc 100" electrode. A heavily coated electrode of the shielded-



"In 12 years, we have never had a battery failure with EXIDE-IRONCLADS"

Exide IRONCLAD BATTERIES With Exide MIPOR Separators "MIPOR," Reg. U. S. Pat. Off.

"IN 1924 we purchased two electric industrial trucks equipped with four 12 MVM-19 Exide-Ironclad Batteries to be used in twenty-four hour service. These batteries were renewed in 1929 with new Exide-Ironclads of the same size after they had given an average life of sixty-one months. Last year, we again renewed three of these Exide-Ironclads that had given an average life of seventy months.

"During this long term of service, we did not have a single battery failure nor any repair expense on the batteries."

These are the comments made by a prominent user of electric industrial trucks. Such experiences are by no means unique, for the Exide-Ironclad Battery consistently delivers this type of long and faithful service, requiring at all times only a minimum of maintenance.

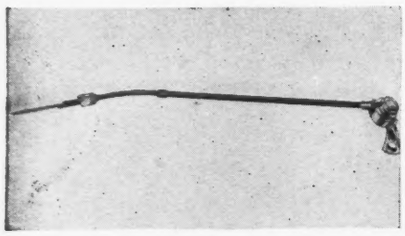
In material handling and cargo handling, where the service must be continuous, speedy and utterly dependable, you will find that Exide-Ironclads can improve your service and cut costs. Write for free booklet, "In Selecting Any Motive Power Battery Be Sure."

Truck illustrated made by Baker-Raulang Company

THE ELECTRIC STORAGE BATTERY CO., Philadelphia
The World's Largest Manufacturers of Storage Batteries for Every Purpose
Exide Batteries of Canada, Limited, Toronto

arc type, it is designed for welding steel of high ultimate strength. Suitable for flat, vertical, and overhead welding. In sizes of 1/8, 5/32, and 3/16 in. The Lincoln Electric Co., Cleveland.

Pyrometer



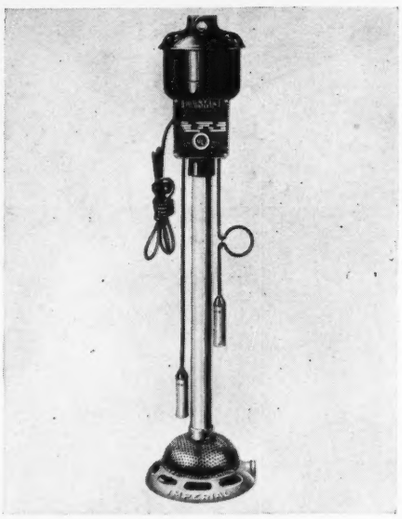
Working on the thermo-electric principle, the "Pyramid Pyrometer" features convenience of adjustment. Screw adjustment on face of dial is easily moved by operator's thumb, making possible constant perfect calibration. Flexible end can be adjusted through 180 deg. All electrical parts and connections are inclosed. Pistol-grip handle houses pyrometer mechanism. Intended for calibration of molten metals, it has separate thermocouple tips for brass and aluminum. Tamms Silica Co., 228 North La Salle St., Chicago.

Humidifier

Model D humidifier is a disk-type machine. Water passes through a sensitive control and is delivered to the disk revolving at high speed. Near outer edge of the bowl are teeth which break the water, coming from the disk at high velocity, into a vapor which is circulated by air current from airplane-propeller-type fan located at back of casing. Totally inclosed motor drives the unit through a flexible coupling. Automatic control governs amount of moisture in accordance with changes in atmospheric conditions. Southworth Machine Co., 30 Warren Ave., Portland, Maine.

Sump Pump

Floatless electrical control operates this automatic, electric, centrifugal sump pump. Motor is controlled by two electrodes hanging in pit at depths where starting and stopping of the pump are desired. As water rises above upper electrode, operation starts; when it goes below lower electrode, motor stops. Water can be pumped down to within 3 in. of bottom of the pit. Strainer can readily be lifted to top of shaft for cleaning. Brass and bronze construction. Six models to take care of practically all sump depths. Imperial Brass Mfg. Co., 1200 West Harrison St., Chicago.

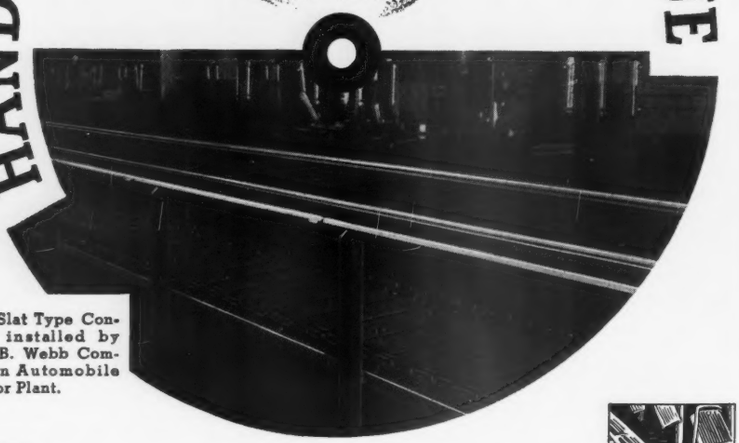


Erratum

On page 80 of the January issue, the package handling hand truck of Service Caster & Truck Co., Albion, Mich., was shown under description of the dry electrolytic capacitors of Cornell-Dubilier Corp., South Plainfield, N. J., while illustration of the capacitors appeared with the truck description.

HANDLING ADDS COST—NOT VALUE

You can't pay dividends or wages out of cost



Wood Slat Type Conveyor installed by Jervis B. Webb Company in Automobile Radiator Plant.

EVERY time material is moved in your plant, it costs you money . . . and doesn't add a particle of value to your product.

Handling is all cost, and no profit. Obviously increased dividends and higher wages can come only from profit. ***Only cost reduction can increase your volume to the point where your operation grows and you can employ more men.*** Hence, you must have lowest possible material handling cost.

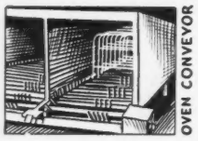
Jervis B. Webb Company has, for many years, provided it . . . in the widest variety of industries. We build or furnish any type of conveyor . . . and our engineers are expert at combining the proper types to your individual needs.

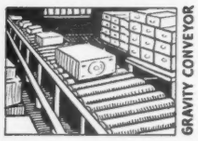
Let us show you what we can do. Write . . .

JERVIS B. WEBB COMPANY

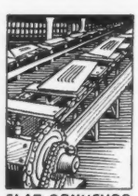
Conveyor Engineers and Manufacturers

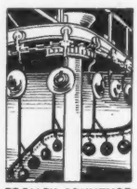
9001 Alpine Avenue • DETROIT, MICHIGAN





BELT CONVEYOR


SLAT CONVEYOR

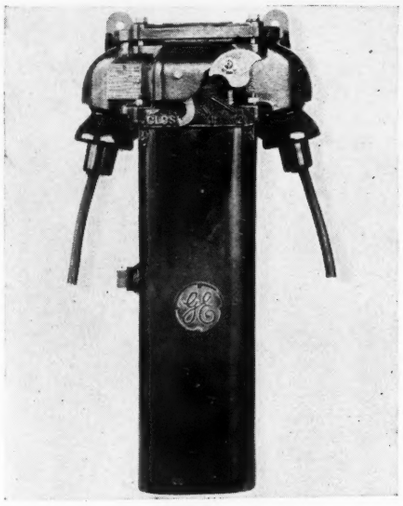

TROLLEY CONVEYOR

Screenings Shredder

Complete compact unit known as the "Rex Titurator" is designed for use in disintegrating sewage screenings. It shreds rags, papers, and organic solids so completely with its 350,000-blade cuts per min. that they can be returned to the sewage flow. It is only necessary to connect water and electric power lines to make unit ready for operation. Equipment includes feeder pan and rake with water piping assembly and mounting. Can be installed with new or existing racks with hand or mechanical cleaning. Chain Belt Co., Milwaukee.

Recloser

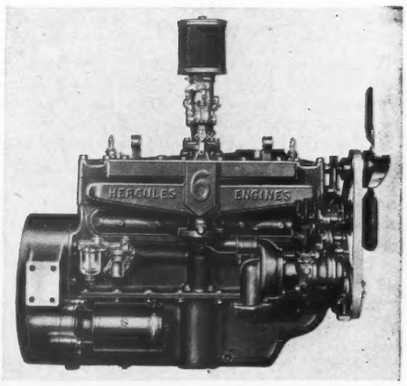
Four-ampere unit has been added to line of FP-19 oil circuit reclosers. This recloser operates normally closed. Trip coil is inclosed in steel casing and receives energy from fault current which picks up



armature, starting movable contact of interrupting element. A short circuit causes contact to open, the arc drawn being extinguished by oil blast action. Unit which opens circuit when line fault occurs recloses after 3-sec. interval. If fault hasn't cleared, circuit is reopened. Adjustment can be made for 1, 2, or 3 reclosures. If fault is still in line after last reclosure, the device locks open and must be reset manually. General Electric Co., Schenectady, N. Y.

Engines

"QX" series engines are heavy duty 4- and 6-cylinder units. Model "QXA" has 3⅛-in. bore, 4½-in. stroke. Model "QXB" has 3¼-in. bore, 4½-in. stroke. The two models are identical in general design. Both models develop capacity at 3,000 r.p.m., "QXA" developing 55½ hp., "QXB" 60 hp. Full packless lubricated water pumps, with cooling water completely surrounding valve seats. Force feed lubrication to all main and connecting rod bearings. Crankcase is cast integral with cylinder block. Pistons are normally of cast iron but can be furnished in aluminum. Engines are of L-head type and valves have 45-deg. seats. Hercules Motors Corp., Canton, Ohio.



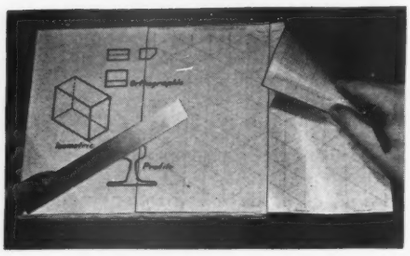
Safe and Easily Cleaned

• Nonskid surface in all four directions means extra safety where Inland 4-Way Floor Plate is used. Also it's easily kept clean. It can be swept and it drains equally well in all four directions. 4-Way Floor Plate should be installed wherever there is need for safety and long wear—around machines, on walkways, steps, loading platforms or aisles where traffic is heavy. Write for our new 16-page catalog illustrating applications.

INLAND STEEL COMPANY
38 South Dearborn Street, Chicago, Illinois
INLAND STEEL

Sketch Set

Consists of pad of tracing paper, two-faced printed guide sheet, and thin steel straightedge. Can be used to make any type of drawing to any scale, freehand or with the straight edge. Guide sheet, which slips under top sheet of the pad, has isometric design on one side, while the reverse side is printed with horizontal and vertical lines 8 to the inch. Inch, ½-in., and ¼-in. spaces are indicated on both sides. Guide sheet is buff colored to prevent eye strain, and has blue lines to contrast with the black pencil lines. It has protective coating, making it moisture-, dirt-, and crack-proof. Three sizes: 5½x8½, 8½x11, and 11x17 in. Wade Instrument Co., 2246 Brooklyn Station, Cleveland.

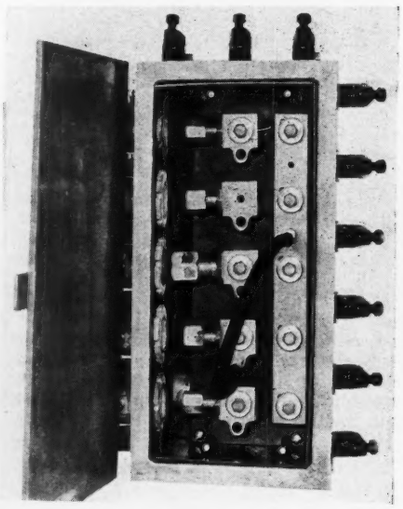


Plating Rack Coating

Synthetic gum coating in liquid form can be applied cold by brushing, spraying, dipping. Not affected by acid or alkalis, "Zetyl" is said to be applicable to all plating operations. It dries in 24 hours. Temperatures under 190 deg. F. do not soften it. Nelson J. Quinn Co., 13th St., Toledo, Ohio.

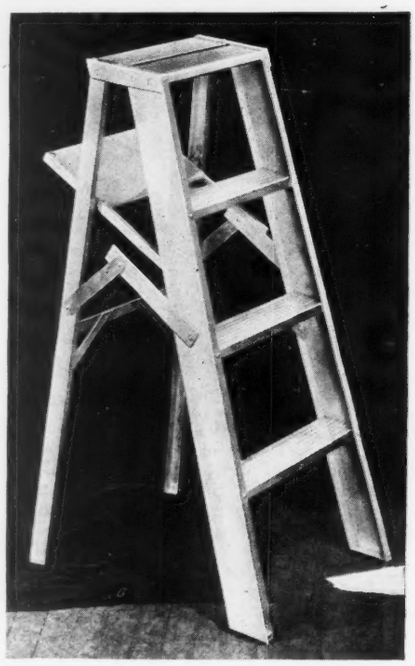
Junction Boxes

Welded "Everdur" junction boxes are corrosion-resistant and moisture-proof. They can withstand accidental impact and are said to be light in weight and easy to install. Available in wide variety of sizes and shapes. Anaconda Wire & Cable Co., 25 Broadway, New York.



Stepladder

Aluminum stepladder is light in weight, rigid, durable. Can be cleaned by scalding with steam, making it suitable for food industries, dairies, breweries, etc. It can also be used under hazardous conditions for aluminum cannot throw a spark. Four-foot size weighs 12 lb.; 6-ft. size, 18 lb.; 8-ft. size, 24 lb. Aluminum Ladder Co., Tarentum, Pa.



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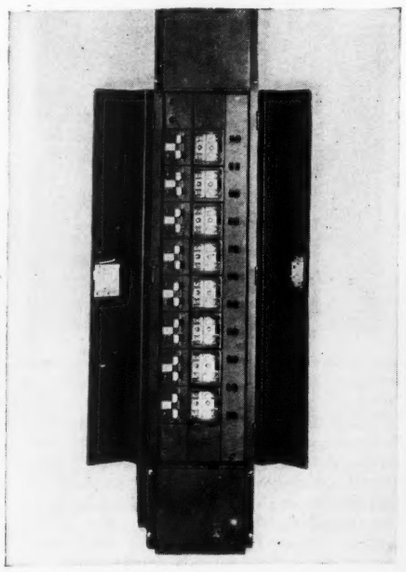
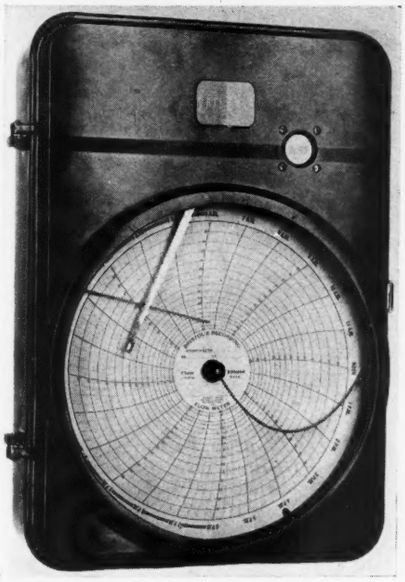
Lighting Panelboards

"Narrow Type" lighting panelboards are designed for installation in narrow spaces. They are 8⅞ in. wide by 4¼ in. deep. Wireway extensions above the panel proper terminate in a pull box, eliminating conduit risers and fittings. The extensions and pull box are integral parts of the panelboard, but their use is optional. Two doors, both with locks, cover, respectively, the fuses and gutter, and the switches. Available for 12-24 circuits in multiples of 2 circuits. Bull Dog Electric Products Co., Detroit.



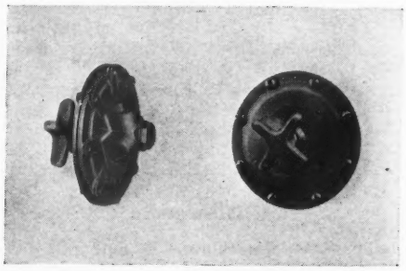
Flow Meters

Line of electric flow meters for steam, liquids, and gases. Can be furnished for recording, integrating, and indicating flow. Operates on Metameter principle of telemetering. Readings are transmitted over two-wire circuit. All electrical contacts are inclosed in glass. Both transmitter and receiver are equipped with moisture, fume, and dustproof aluminum alloy cases. Has conduit openings. The Bristol Co., Waterbury, Conn.



Air Regulator

Type HFS low-capacity regulator for sensitive regulation of air pressures below 30 lb. Has large diaphragm with 4-in. diameter effective area. Diaphragm is clamped between two zinc die castings fastened together by radially spaced bolts. High pressure from main air line enters on side away from diaphragm side of valve. It is claimed regulated air pressure can be graduated up to 30 lb. with but 1 oz. of variation for each 10-lb. variation of main line pressure. The DeVilbiss Co., Toledo, Ohio.



Babbitt

Composed of 86 per cent tin, 6–7½ per cent antimony, 5–6½ per cent copper. For bearing service where high speeds, severe vibration, shock and impact loads, excessive temperature are encountered. Comes in 4-lb. divisible bars. Bunting Brass & Bronze Co., Spencer St., Toledo, Ohio.

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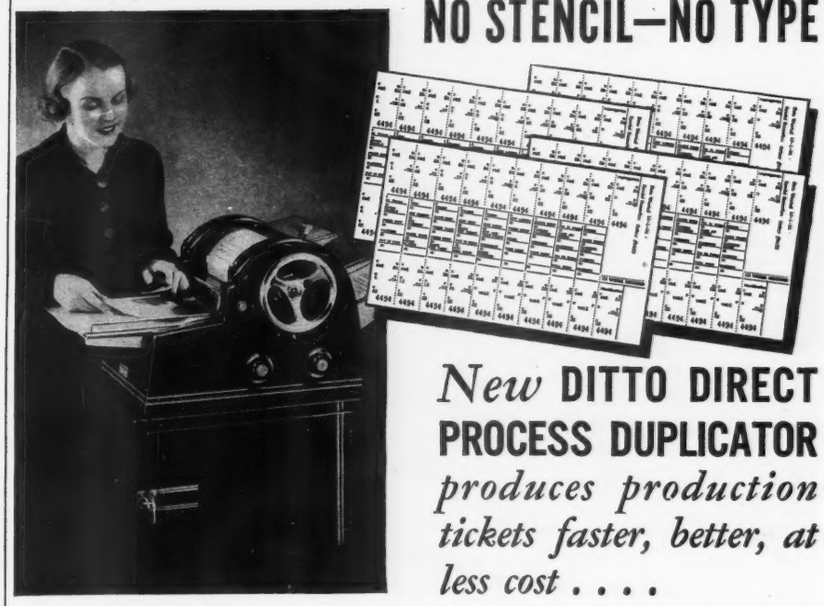

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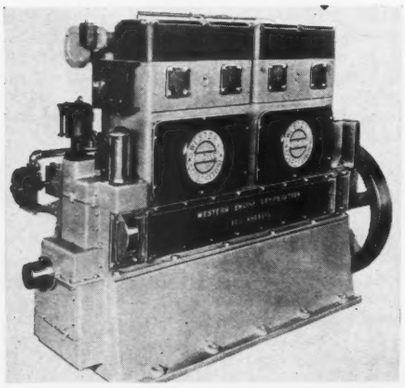
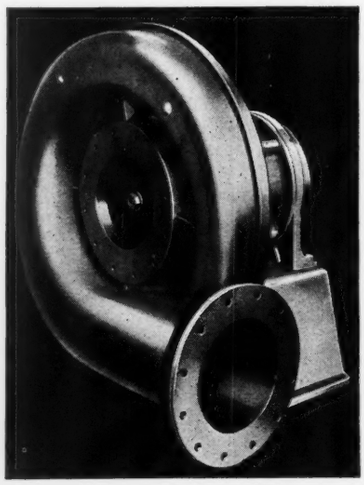
Diesel Engine



Type D diesel, for stationary service, is available in 2-, 4-, and 6-cylinder models, developing 50, 100, and 150 hp. It has 7¼-in. bore, 8-in. stroke. Totally inclosed. Equipment includes governor, lubricating oil cooler, oil filter, crankcase breathers, centrifugal or gear-type lubricating water pump. Starting is by air. Cast iron base with oil reservoir carrying crankshaft. Crankshaft is drilled for pressure lubrication to the crankpin and piston pin bearings. Camshaft is lubricated by separate oil line. Upper part of crankcase is provided with aluminum inspection doors. Can be converted to natural gas operation. Western Engine Corp., Los Angeles.

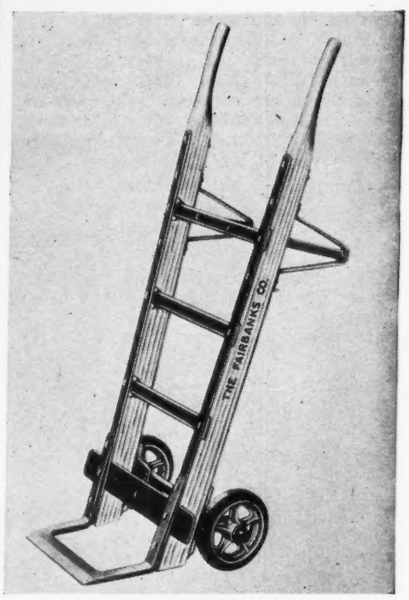
Blower

Type CS Motorblower is especially designed for services requiring air at 1-lb. pressure, in volumes 325-3,200 cu.ft. per min. Can be adapted to oil- or gas-fired furnaces to furnish air at practically constant pressure, regardless of variation in number of burners in use. One-piece, cast aluminum alloy impeller. Ingersoll-Rand, 11 Broadway, New York.



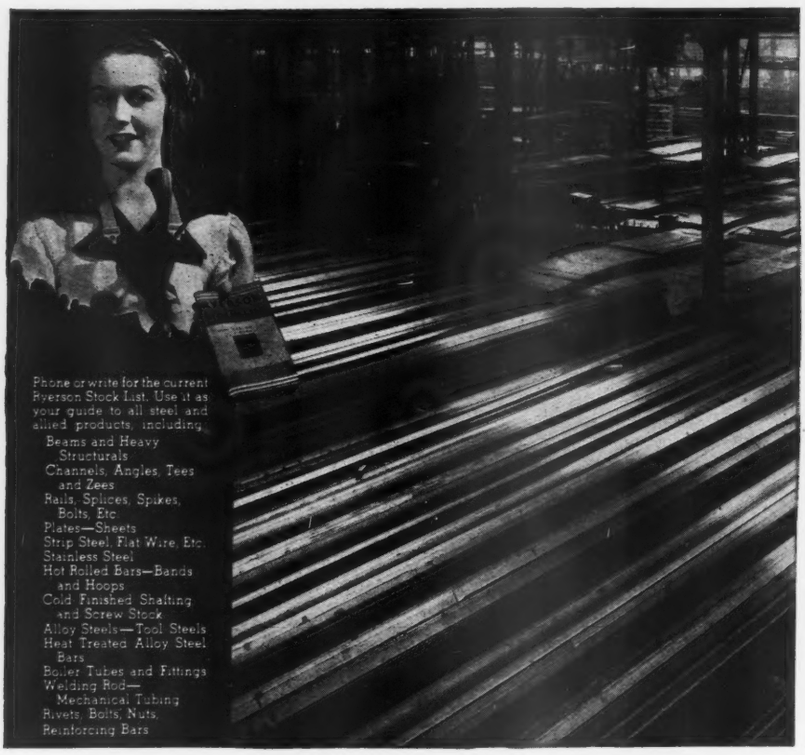
Hand Truck

No. 9,000 truck has wooden frame reinforced both front and back with steel straps extending full length of the handles. Crossbars are channel-shaped pressed steel and fit into rabbeted depressions in top of the handles, to which they are rigidly bolted. Nose iron is placed over handle strips, and wheel guards are integral with lowest crossbar. Wheels are slightly crown faced to provide easier operation and prevent damage to floors. Can be furnished with rubber-tired wheels. The Fairbanks Co., 393 Lafayette St., New York.



Water Filter

Type AWF automatic water filter for filtering raw water. Porous filter tubes can be supplied in different porosities to give different degrees of filtration. One extreme is crystal clear water, the other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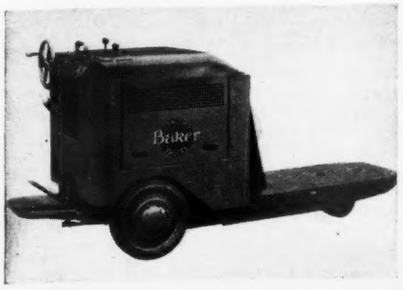
the passage of solids 0.0039 in. in diameter. The accumulation of solids is automatically eliminated by an automatic backwash. Drive is by means of a 1/15-hp. universal motor which rotates a valve alternately, leading compressed air to the various actuating pistons. R. P. Adams Co., 220 Delaware Ave., Buffalo, N. Y.

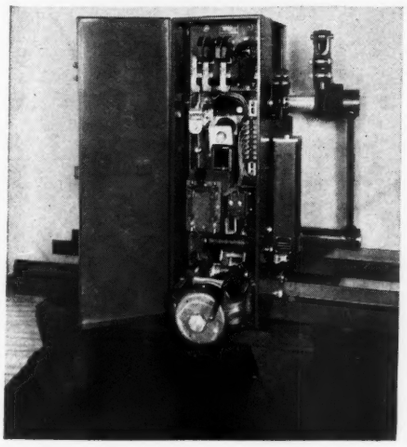


Trucks

Line of gasoline-powered elevating platforms of 3, 4, and 5 tons capacity. Hercules type IXB engine developing 46½ hp. at 3,200 r.p.m. Hydraulic elevating system with pump driven by triple V-belt from engine crankshaft. Maximum speed of 10 m.p.h. but governed speed of 7½ m.p.h. is set. The 3-ton truck is 115½ in. in length overall; platform is 55 in. long. The two larger models are 117⅝ in. in overall length. All controls conveniently located. Steering operates on all wheels and is actuated by vertical handwheel. Baker-Raulang Co., 2178 West 25th St., Cleveland.

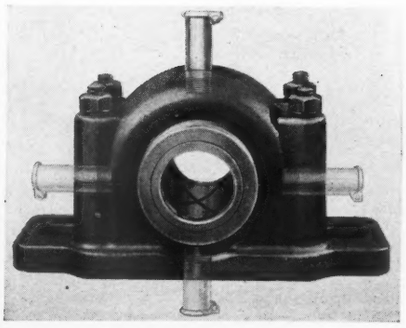
Circuit Breakers

New operating mechanism for Type FH oil circuit breakers is designated MK-110. By increasing opening springs and modifying trip mechanism to reduce friction, faster opening time is obtained. This permits rating all breakers 600-4,000 amp. at 8 cycles. Has easily operated hydraulic device for manual closing. Easily adjustable cut-off switch. General Electric Co., Schenectady, N. Y.



Pillow Block

Universal "Double Reservoir Oil Return" pillow block can be mounted in any position. It is necessary only to select the mounting position needed, unscrew the oil cup, turn the ball to this position, and reinsert the oil cup vertically. There are



two large reservoirs in the spherical ball. Oil is placed in upper of two large reservoirs and is fed to shaft as needed through graphite feed plugs and graphite pressure-packed channels. Oil recovery grooves divert unconsumed oil into lower wool-packed reservoir. This oil is again fed to shaft and bearing through graphite feed plugs. Bearing is self-aligning and precision bored. It is said it will operate efficiently on high-speed applications. Randall Graphite Products Corp., 609-613 West Lake St., Chicago.

Psychrometer

Motor-operated aspirating psychrometer is equipped with easy reading canary-colored mercury thermometers. Operates on principle of drawing air at proper velocity by motor-driven fan across mercury bulbs of two thermometers. Ther-

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No matter what bonding or rust-prevention process your company has been using these past years, you will want to look into this new Marks Bond process.

Your present equipment may be used. Saves time on processing. This bonding process has proven effective under many commercial tests and will give a satisfactory coating in 30 seconds. • It permits a saving on equipment space. • Saves on fuel and heating of tanks, requiring a solution of only 140 to 160 degrees. • Sludge practically eliminated. • Has passed salt spray and humidity tests. • Gives controlled etching—light or heavy. • Has been officially approved by several of Detroit's largest industrial plants.

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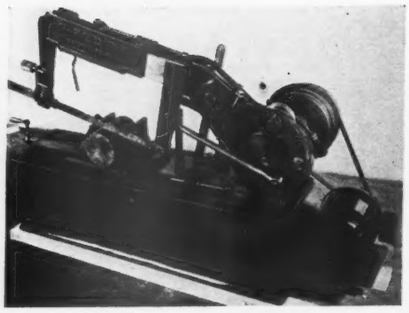
mometers are calibrated in single degrees and have range of +30 to +120 F. Two portable types: one a self-contained battery unit operating on lantern batteries, the other a plug-in unit for 110-volt, 60-cycle a.c. operation. Mounted in carrying case, front part of which is removable. H-B Instrument Co., Inc., 2518 North Broad St., Philadelphia.

Power Hacksaw

Equipped to use 12 or 18-in. blades, this power hacksaw can saw up to 10 x 10-in. stock. Relieving mechanism is operated by cam, rack and pinion, and friction clutch. Blade is raised at extreme end of cutting stroke, and lowered to cutting position at completion of return stroke. Driven by 1-hp. motor with V-belt and 3-step sheaves,



driving through a planetary gear reducer, having case hardened gears operating in an oil bath. Three speeds are 80, 100, and 126 r.p.m.; three other speeds of 90, 108, and 118 r.p.m., can be had by shifting motor on sliding rod. Kelley Gear & Tool Co., 1406 West State St., Bristol, Tenn.

Change of Name

American Chain Co., Inc., has announced a change in corporate name to that of American Chain & Cable Co., Inc. General executives offices remain at Bridgeport, Conn., and 230 Park Ave., New York.

•

Allis-Chalmers Mfg. Co., Milwaukee, has announced that its subsidiary, Condit Electrical Mfg. Corp., 1344 Hyde Park Ave., Boston, is now being operated as a company unit under the name of Allis-Chalmers Mfg. Co.—Condit Works.

•

Robert Gair Co., Inc. has acquired the business of Pa Pro Co., Utica, N. Y., and of Holyoke Fibre Box Co., Inc., Holyoke, Mass. The two corrugated shipping container units will be operated as the company's Pa Pro Containers Division and Holyoke Fibre Box Division.

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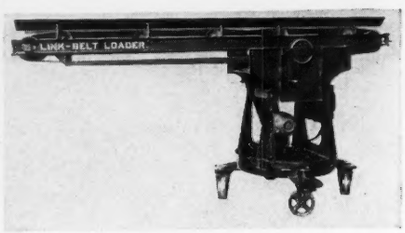
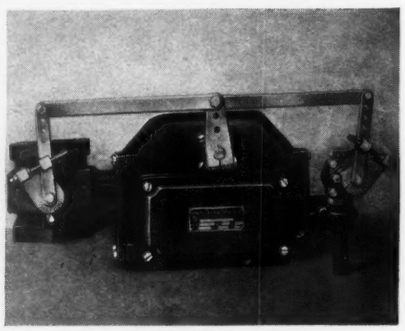


Box Car Loader

Handles bulk materials without creating much dust or degradation. Anti-friction belt conveyor constituting loading element is supported on a horizontal boom. Boom can be racked back and forth and rotated 360 deg. by hand. Conveyor has discharge height of 5 ft., and is operated at slow speed. Unit is mounted on large swivel casters. Link-Belt Co., 2045 West Hunting Park Ave., Philadelphia.

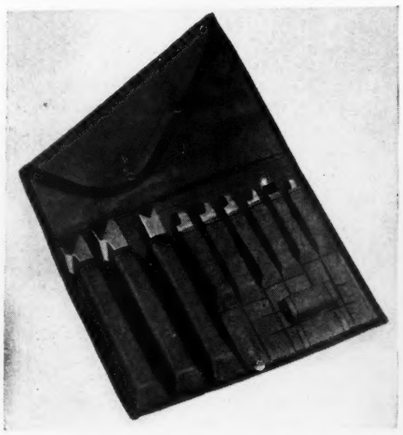


Controller

The "Balancer" is an electrically operated temperature control mechanism, automatically compensating for drastic load changes. It is designed for use when load changes of long duration are encountered. It sets up a new normal based on the sustained change in fuel demand, and controls from this new "average demand" as long as conditions require. Automatic Temperature Control Co., 34 East Logan St., Philadelphia.

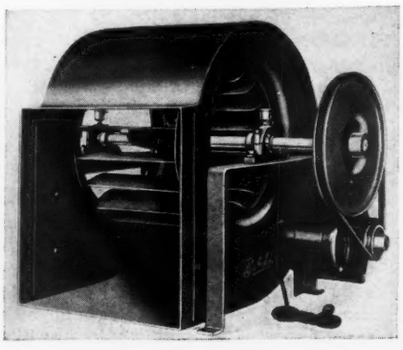
Carbide Tools

Carboloy Tool Kit contains 9 Carboloy tools for general machining operations, a 20-page booklet showing new, rapid grinding technique, and a 12-page booklet showing 50 suggested applications for the 9 tools. Tools are complete except for grinding, which user does in his own plant. Object of this is to make possible a saving in investment cost to the user. Particularly adapted to small shops. Carboloy Co., Inc., Detroit.



Fans

Type "H.V.A." fans for forced warm air circulation are now available with motor and one-piece motor mounting. Quiet operation is assured at speeds recommended, for bearings are floated on rubber insulators and the bracket for mounting the motor is rigid and will not vibrate. No. 121 has rated fan speed of 490 r.p.m., and free delivery of 800 cu. ft. per min. No. 151 has rating of 400 r.p.m. fan speed, 1500 cu. ft. per min., free delivery. Both fans employ 1/6-h.p., 110-volt, 60-cycle, single-phase motors. Both fans will deliver large volume of air against back pressures encountered in air conditioning systems. Buffalo Forge Co., Buffalo, N. Y.



Flexible Shaft Grinders

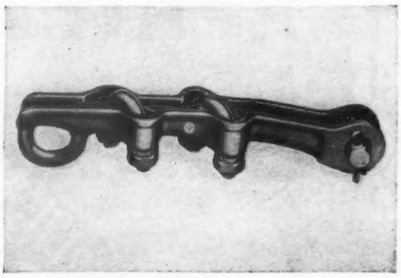
Improved Series 1500 and 4500 flexible shaft grinders have a clamping bracket at top of the stand, making possible rigid mounting of the wheelhead. Machines are equipped with V-belt drive. Available in five sizes, ranging ¼-2-hp. in capacity. Size of grinding wheel ranges from 4 x 1 x ½-in. on ¼-hp. machine to 10 x 1 x ½ in. on 2-hp. unit. Swartz & White Mfg. Co., 215 Washington St., Binghamton, N. Y.

Saw Guard

No. X24 saw guard can be used on stationary, tilting table, or tilting arbor saw benches. It is designed for saws, 8-18 in. in diameter. It is self-adjusting, up and down, regardless of whether saw is vertical or tilted to 45 deg. As lumber presses against it, it rises and rests lightly upon the board, falling automatically into place after the stock has passed through. American Saw Mill Machinery Co., Hackettstown, N. J.

Straight-Line Clamp

For dead-ending or for line use, the "Strateline" can be employed. With it, no intermediate fittings are necessary when dead-ending cable buses. Made of galvanized malleable iron. Three sizes for cable diameters 0.28-0.43 in., 0.42-0.55 in., and 0.54-0.68 in. Can be furnished with socket eye, a clevis, or no fitting. Ohio Brass Co., Mansfield, Ohio.



(Continued on page 88)

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ON GOES FENESTRA HOLORIB, QUICKLY

See how quickly and easily Fenestra Holorib Steel Roof Deck, insulation and waterproofing GO ON when the old roof is obliged to COME OFF.

Holorib is the ideal roof replacement material. It can be supported by any framing that properly carried the old roof, for its extremely lightweight makes reinforcement unnecessary. Holorib sheets can be designed for any previously used purlin arrangement and are quickly trimmed to fit snugly around vents, skylights and other irregularities.

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Other advantages: Telescoping end laps and interlocking side laps prevent asphalt dripping; can be insulated to any required degree to prevent condensation; can be laid in almost any weather; nothing to pour, freeze or dry out; applicable to flat, pitched, saw-tooth, monitor, bow-string or curved surfaces on all types of buildings; can be finished with slate, shingles or tile for architectural appearance; saves winter fuel; promotes summer comfort; undersurface forms an attractive ceiling, smooth, dry and ready for immediate painting.

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There is a "Pittsburgh" warehouse near *you*—carrying a complete stock: *Gold Stripe* brushes for all types of paint jobs, both maintenance and production; floor sweeps and mill dusters and many special types such as wire scratch and casting brushes.

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Engineering representatives, trained in modern production problems, are available from the factory upon request. They are prepared to offer recommendations for the efficient use of wire wheels and wire and tampico sections, also refillable spiral wound brushes for large scale production in various industries.

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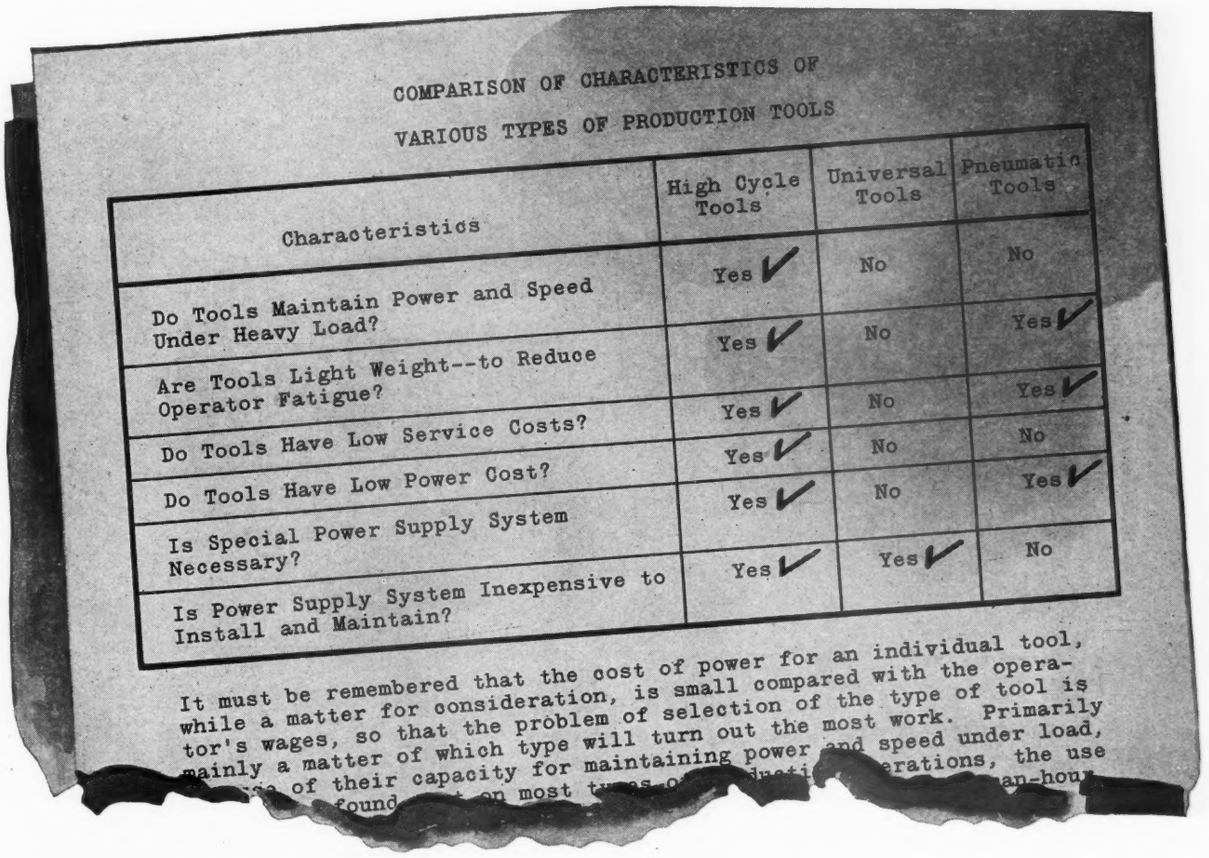
Sayings and Doings

Hours, Jobs and Welfare

In its annual report the Brookings Institution returns once more to a point that it has emphasized several times in the past. This is the complete fallacy of the belief that we can restore employment and prosperity by a further reduction in working hours. Yet the leaders of the American Federation of Labor still cling to this belief. Even if there were little likelihood that the prevalence of this view may lead to a demand to establish a maximum thirty-hour week by law, the view affects economic policy at so many points that it is of the utmost importance for us to arrive at sound conclusions regarding it.

Those who hold the belief begin by assuming that the number of jobs is relatively fixed. If there are fewer jobs than men, nothing seems to them more natural than to cure this condition by shortening the working hours of each employed man, thus forcing employers to take on more men to do the same number of hours' work as before. When the reply is made that this will compel all men at present employed to take a corresponding cut in wages, the answer comes that of course employers should be compelled to pay the same amount for the shorter working week as they did for the longer one.

This way of conceiving the problem is as fallacious as it is naïve. The number of available jobs is not fixed. It depends upon a complex of conditions, particularly upon the interrelationships of prices and wages. If weekly hours were reduced in a given industry from forty to thirty, for example, and hourly wages in that industry were raised 33 1/3 per cent to compensate for this, it by no means follows that 25 per cent more employment will also be created. On the contrary, the result could easily be a reduction in employment. The violent increase in labor costs would either wipe out profit margins of many firms, and compel them to close, or it would lead to a corresponding increase in the price of the product made by that industry. So sharp an increase in prices could hardly fail to reduce the market for that product, and this result would also reduce the number of jobs. If we imagine the thirty-hour week adopted in all industries we should have all these bad results and one more. The rise of prices all around the circle would so reduce purchasing power that even though wages with the shorter



COMPARISON OF CHARACTERISTICS OF VARIOUS TYPES OF PRODUCTION TOOLS

Characteristics	High Cycle Tools	Universal Tools	Pneumatic Tools
Do Tools Maintain Power and Speed Under Heavy Load?	Yes ✓	No	No
Are Tools Light Weight--to Reduce Operator Fatigue?	Yes ✓	No	Yes ✓
Do Tools Have Low Service Costs?	Yes ✓	No	Yes ✓
Do Tools Have Low Power Cost?	Yes ✓	No	No
Is Special Power Supply System Necessary?	Yes ✓	No	Yes ✓
Is Power Supply System Inexpensive to Install and Maintain?	Yes ✓	Yes ✓	No

It must be remembered that the cost of power for an individual tool, while a matter for consideration, is small compared with the operator's wages, so that the problem of selection of the type of tool is mainly a matter of which type will turn out the most work. Primarily of their capacity for maintaining power and speed under load,

What Types of Plants should Install High Cycle Tools?

THERE is no fixed rule. Experience has shown that almost any plant which uses ten or more Universal or Pneumatic Portable Tools in a group can effect important savings by replacing them with High Cycle Tools. In some cases, worthwhile economies have been effected by replacing an even smaller number of Universal or Pneumatic Tools with High Cycle.

A glance at the chart above will show you several reasons for these savings, but one of the most important is this: High Cycle Tools register only a 20% decrease in speed between no-load and stall points, which compares with a decrease up to 60% on Universal and Pneumatic Tools. This is particularly important on tools like sanders and grinders, because a decrease in the speed of the tool results in an additional decrease in the cutting efficiency of the abrasive and a corresponding increase in the time necessary to do the work.

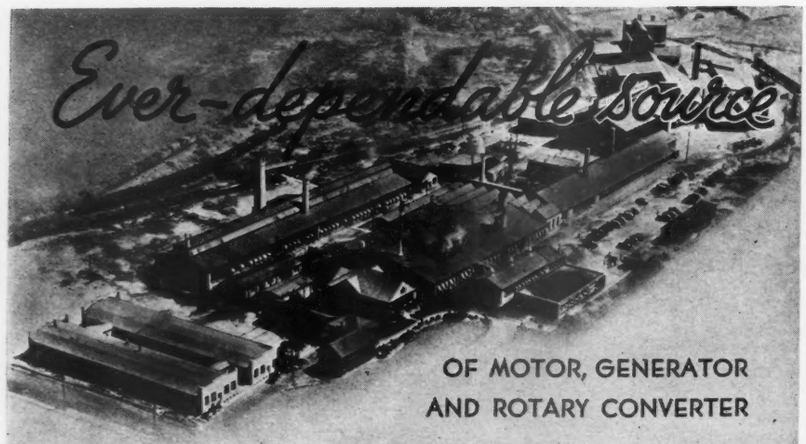
How Much Will High Cycle Tools Reduce Your Production Costs?

It's easy to find out definitely. Our High Cycle engineers will be glad to make a study of your production operations and give you a report on the economies which can be effected through the use of High Cycle, without cost or obligation on your part. For further information and catalog, write to: High Cycle Division, Black & Decker-Van Dorn, 719 Pennsylvania Avenue, Towson, Maryland.

BLACK & DECKER-VAN DORN High Cycle TOOLS

Made by the World's Largest Manufacturers of Portable Electric Tools

DRILLS REAMERS SCREW DRIVERS NUT RUNNERS TAPPERS STUD SETTERS
PORTABLE SANDERS PORTABLE GRINDERS DIE GRINDERS



OF MOTOR, GENERATOR
AND ROTARY CONVERTER

BRUSHES

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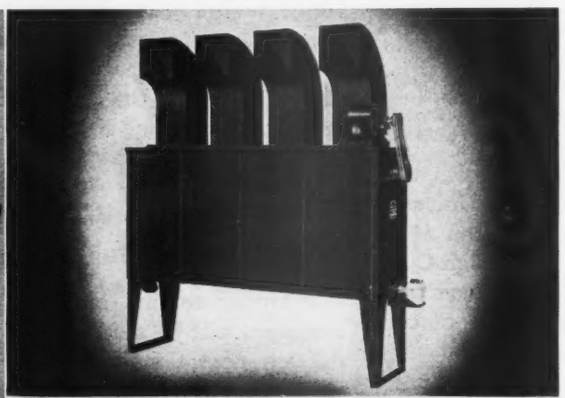
SPEER
CARBON COMPANY
ST. MARYS, PA.

and sound engineering service to insure best results in any application, based on 39 years of specialized experience, intensive research, pioneer development, uninterrupted progressiveness and unsurpassed manufacturing facilities.

Tests on your machines will demonstrate the many advantages of specifying SPEER brushes. Try a set on your most difficult application. Write for our engineering advice and service.

Save Fuel!
Save Piping!
Save Traps!



UNITHERM UNIT HEATERS

with Syncrotherm Control at No Extra Cost

Decidedly different is our principle of large space, industrial heating. We recommend Clarage Floor-Mounted UNITHERM Unit Heaters equipped with Clarage Syncrotherm Control. It is Syncrotherm Control (patented feature) which enables us to show such substantial savings in fuel cost.

With Syncrotherm Control the unit heater fans operate ALL the time during working hours, giving a continuous NON-STOP circulation of warm air.

To maintain any desired temperature, Syncrotherm Control regulates the amount of air passing THROUGH AND AROUND the heating coil. Marked economies in operating cost are the result. No hot ceilings — no cold floors! Syncrotherm Control makes Clarage UNITHERM Unit Heaters EASY on the coal pile.

Then, too, our floor mounted units utilize a very simple heating layout. There is invariably LESS piping and FEWER traps required — big saving in installation cost.

Before you buy, at least be informed on this latest factory heating development. Get a complete explanation of Syncrotherm Control by writing for Clarage FREE Bulletin 103.

SPECIFY CLARAGE for
COMPLETE AIR CONDITIONING
VENTILATION
HEATING
COOLING
MECHANICAL DRAFT
FANS & BLOWERS FOR INDUSTRIAL NEEDS

CLARAGE FAN COMPANY • Kalamazoo, Mich.
SALES ENGINEERING OFFICES IN ALL PRINCIPAL CITIES

week were nominally the same, living standards would drop.

There is nothing paradoxical in these conclusions. What is really astonishing is the fixity of the notion that we can all become richer by working less.

There can be no defense, of course, of hours so long that they undermine the health and energy of workers or fail to allow leisure for a decent, rounded life. Such hours, by reducing efficiency, are usually harmful to the very employers who insist on them. But the present controversy does not involve this point. In his letter to Speaker Bankhead yesterday, for example, the President expressed concern about the effect on re-employment of an increase in average weekly hours in manufacturing industries from 33.3 in September, 1934, to more than 40 in October of last year. An average working week of this length hardly seems unreasonable. The increase appears to be owing mainly to putting men on full time who were previously on part time. When this process has been completed, the rise in employment may be a very rapid one.

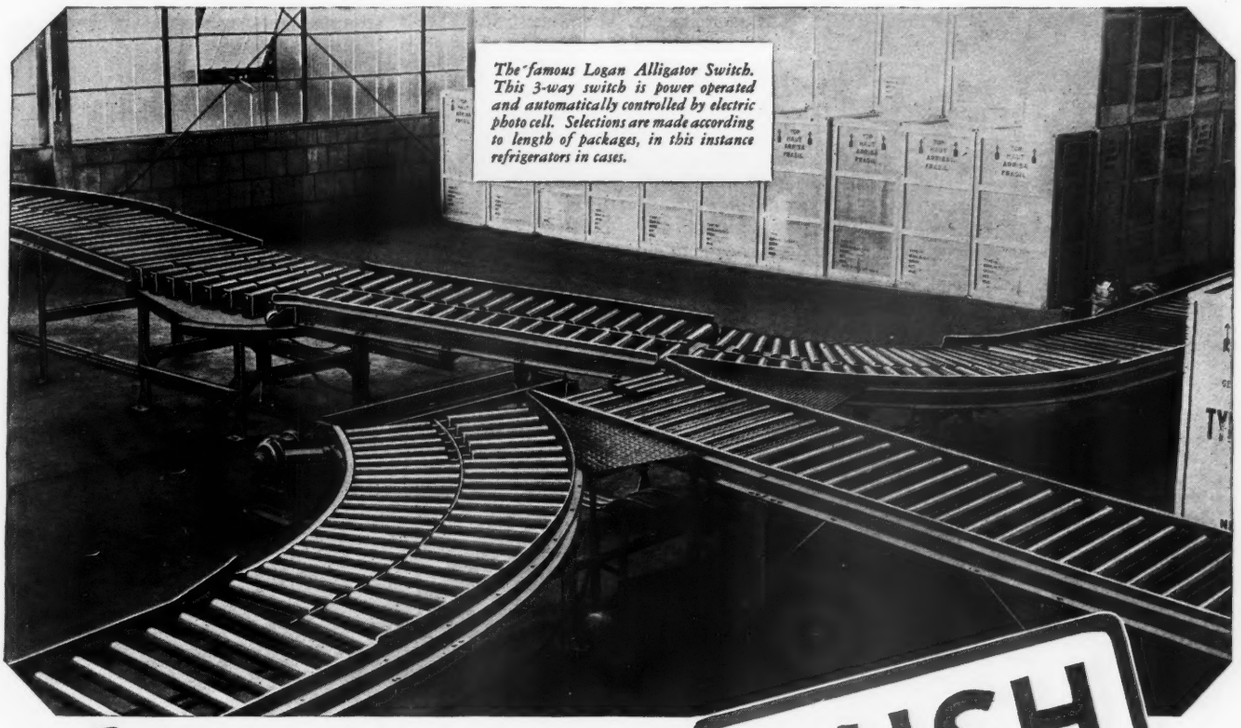
The President's letter, incidentally, implies that the volume of employment depends entirely upon the "cooperation" of private industry. It is a profound mistake, however, to assume that the giving or withholding of jobs by employers is primarily a voluntary act. That there were only 45 per cent as many men building locomotives last September as in the 1923-25 period, and 530 per cent as many building airplanes, does not mean that the aircraft manufacturers were "cooperating" furiously and the locomotive manufacturers not at all. It means merely that conditions beyond the control of individual manufacturers were different in each industry. Governmental policy is just as responsible for the conditions of employment as private industry is.—*The New York Times.*

•

Lincoln Arc Welding Foundation

Dedicated to encouragement of study and research for benefit of the arc welding industry, "The James F. Lincoln Arc Welding Foundation" has just been established by the directors of The Lincoln Electric Company. One of its primary functions will be the stimulation of original design in order that arc welding processes may be more widely utilized in modern-day fabrication.

Principal direction of the Foundation's work will be given by Dr. E. E. Dreese, head of the Department of Electrical Engineering at The Ohio State University. Dr. Dreese is an outstanding member of the American Institute of Electrical Engineers, and has wide connections in the field of general science. His important position with the Foundation places its program on the highest possible plane.



The famous Logan Alligator Switch. This 3-way switch is power operated and automatically controlled by electric photo cell. Selections are made according to length of packages, in this instance refrigerators in cases.

Who gets the RUSH and what to do about it

Same Alligator in an alternate position. These switches may be full automatic, push button controlled or manually operated, as conditions require.

★"How soon can you ship the Jones order? What's the status of the Smith job? Remember we've got to give service . . . etc. . . . etc!!" And so, far into the day, goes the house phone between sales department and shop in every manufacturing plant.

Customers (doggone their hides!) delay ordering until the last minute, then there's order checking, material to come in, and other delays. Finally the production man gets the shop order. And being *the last man* to get it, he also gets . . . *the pressure.* . . . "So what", you ask, "has this to do with Logan Conveyors?" Just this—that a well-planned Logan system for handling materials—from receiving dock right through manufacturing and assembly, and on to storage or shipment—can take the raw edge off rush, tension periods. By putting flow into production, by co-ordinating all activities, Logan Conveyors smooth out plant operation. Ask the nearest Logan engineer or write for bulletin "7 Economies."

LOGAN CO., Incorporated, Louisville, Ky.
510 Buchanan St.

HELP YOU GET OUT THE WORK

Logan Conveyors
LOUISVILLE

EASY ON THIS

Because they have proved definitely economical in actual use, Onliwon Towels are first choice in offices, factories and public institutions from coast to coast. The towels are soft and pleasant to use —inviting the frequent washing that is so effective in protecting health. At the same time, Onliwon Towels combine strength, size and absorbency in such perfect balance it actually takes fewer of them to dry a given number of hands and faces. Phone your local A.P.W. representative today and get the facts on the many advantages of Onliwon Towels dispensed from Onliwon Cabinets. Or, write for samples to: A.P.W. Paper Company, Albany, N. Y.

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Onliwon Towels

SUPER MAKES UP FOR REDUCED MAN POWER

ONE man with a Super does more work, and better, in any given time, than several men with brooms, dusters, or less specialized equipment.

The Super does so many different tasks—capturing dust at machines where produced, cleaning the plant, offices, materials, production equipment, floors, walls, piping and overhead —even the inside of executives' autos. Wherever powerful suction, or blowing, of air can serve, the Super does the job.

Readily adaptable to infinitely various purposes. Moves 190 cu. ft. of air, at 3 miles, per minute. Ruggedly built—no service problem, long life, readily portable. Standard tools, plus simple adaptations to many specialized operations.

It costs you nothing to try a Super. Make your own demonstration under our free trial offer. Write us for data.

The National Super Service Co.

1945 N. 12th Street Toledo, Ohio

Suction Cleaner Specialists for Twenty-six Years

Commenting on the honor just bestowed upon him, Mr. Lincoln said:

"In laboratory, and in mill and factory the world around, scientists and technicians are seeking to develop new phases of the electric arc as a superior welding technic.

"With the aid of the electric arc, many industrial methods and new processes which offer incalculable benefit have been made commonly available. Yet, so recent is the development of arc welding as a practical technic, its full worth has been experienced by not more than one in five potential users.

"The sole purpose of our Foundation is to stimulate the ingenuity of scientists, engineers, and skilled workers interested in extending the frontiers of knowledge and achievement. This arousing of interest will result, I believe, in lower production costs for thousands of devices and commodities now employed in manufacture or moving in commerce; and I feel signally honored in having my name attached to a movement that seeks to give constantly increasing markets the benefit of better, stronger, and more serviceable goods."

•

Group Insurance at Armco

More than $21,000,000 of group life insurance is carried by employees of The American Rolling Mill Company which, twenty years ago, became the first company in the steel industry to provide such insurance for its workers, according to the Equitable Life Assurance Society.

In the first year 1,630 employees purchased $2,211,587 of life insurance in cooperation with the company. Today 12,400 employees, approximately 99 per cent of those eligible, have $21,044,000 in insurance, an average of approximately $1,700 each. In the last twenty years $1,535,465 has been paid 920 beneficiaries.

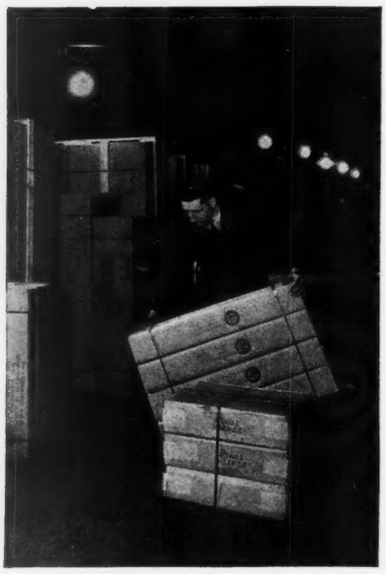
•

Manufacturing Industries Employ 9,889,000

The total number of unemployed workers in November, 1936, was 8,968,000, according to January estimates of the National Industrial Conference Board. This is an increase of 198,000, or 2.3 per cent, from the estimate for the preceding month; and a decrease of 1,786,000, or 16.6 per cent, from November, 1935.

Employment in all types of enterprise in the United States in November, 1936, was 43,855,000 workers. This was a decrease of 148,000 workers, or 0.3 per cent, under October, and an increase of 2,392,000, or 5.8 per cent, over November, 1935.

The number of workers employed in November, 1936, was 3,301,000, or 7.0



● To protect shipments of parts, accessories, etc. of Studebaker passenger cars and commercial vehicles to branches and dealers Studebaker uses SIGNODE Steel Strapping. According to that company money has been saved in labor, time and freight rates, shipping at the rate of over 100 SIGNODE Steel Strapped containers daily.

STRAPPED TO ARRIVE IN *Good Shape*

● Whether it be a small package, a bundle or a hundred-thousand pound load, the protection and reinforcement of SIGNODE Steel Strapping keeps tight control of it from the plant to the buyer. In absorbing transit shocks SIGNODE Steel Strapping is to a shipping container what steel hoops are to a barrel.

In addition to protecting SIGNODE Steel Strapping makes it possible to do away with heavy, expensive packing and lighten and economize practically every type of shipment.

To find out if there are any ways of reducing your shipping and packing costs or improving your containers have a SIGNODE Packing Engineer call or send for Catalog 17-A.

SIGNODE STEEL STRAPPING CO.

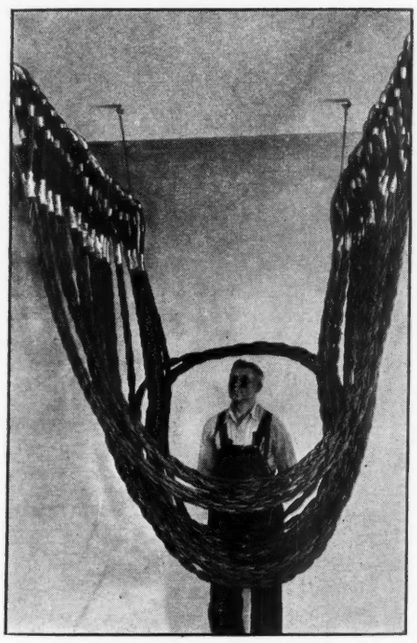
2621 N. Western Ave., Chicago, Ill.
361 Furman St., Brooklyn, N. Y.
452 Bryant St., San Francisco, Calif.

SIGNODE

Better Packing Headquarters

MACWHYTE SLINGS HUG THE LOAD!

New Construction Speeds Loading—Increases Safety—Cuts Materials Handling Costs.



Special Design. An order of Macwhyte Braided Slings fitted with Crescent Thimbles. Macwhyte Slings are custom-built to meet your needs. Available in many special designs.

Because Macwhyte Slings hug the load, they prevent slippage and increase safety.

The multiple-part body does not damage the load. It spreads on corners so that from four to six ropes are in contact with the load.

The multiple-part body is non-kinking, gives maximum flexibility, is light in weight, and safe beyond comparison.

Floormen, Superintendents, Safety Engineers, tell us they are the best slings they have ever used.

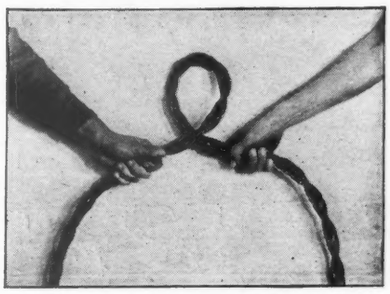
Send for descriptive folders or ask to have a Macwhyte representative call.

MACWHYTE COMPANY
Kenosha, Wisconsin

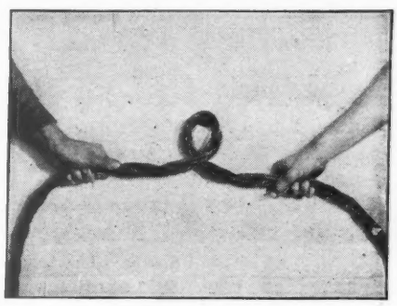
Specializing in the manufacture of wire rope and custom-built wire rope slings.

Distributors throughout the U. S.

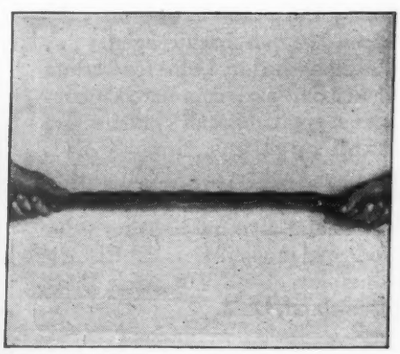
Macwhyte Braided Slings are Flexible and Non-Kinking



Loop in a braided body



. . . pulls down under tension



. . . and straightens out. The flexible braided body of Macwhyte Slings throws out the loop — and in this way resists kinking.

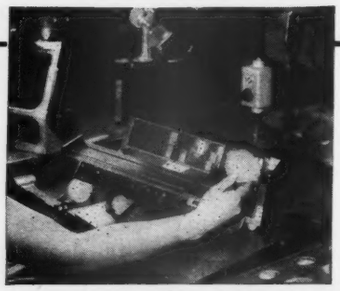
On the Job. Macwhyte Braided Slings are seen here handling sheet packs. On this work, the Superintendents report 6 to 10 times better service with Macwhyte Slings.

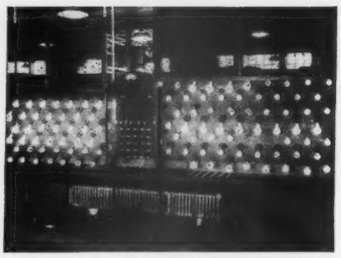
MACWHYTE BRAIDED WIRE ROPE SLINGS
(PATENTED)

AD NO. 257

HOW TO AVOID PAYING FOR WASTED ELECTRICITY

. . . use lamps that Stay brighter longer





You can't save money on light by buying inferior bulbs. "Electric Eye" tests show they often waste as much as 30% of the light you pay for. Instead of saving money when you buy cheaply made bulbs, you usually suffer a loss because of wasted current. General Electric MAZDA lamps are carefully made according to precise, scientific standards . . . standards that are much more severe than Federal Specifications. To insure that these are met and maintained, there are 480 different checks and inspections made in the course of manufacture.

Next time you buy lamp bulbs, follow the example of America's shrewdest purchasing agents . . . the men who buy bulbs for leading industrial and commercial concerns, great railroad systems, and public utilities. Specify G-E MAZDA lamps . . . the kind that *Stay Brighter Longer* than inferior bulbs and give full lighting value for your money. General Electric Company, Dept. 166, Nela Park, Cleveland, Ohio.

• In addition to its own tests, G-E employs the Electrical Testing Laboratories — the largest independent electrical testing organization in America — to test approximately 10,000,000 MAZDA lamps a year. These tests show the amazing fact that less than 1/10th of 1% have defects that will affect their performance.

GENERAL ELECTRIC
MAZDA LAMPS

MAIL THIS COUPON FOR FREE BOOK

LEARN THE REAL FACTS ABOUT LAMP BULBS

GENERAL ELECTRIC CO., DEPT. 166, NELA PARK, CLEVELAND, OHIO.
Please send me free of charge your booklet "They Stay Brighter Longer" containing facts about MAZDA lamps.

NAME.....

COMPANY.....

STREET.....CITY.....STATE.....

F-2

per cent, below the average of 47,156,000 workers employed in 1929.

From October to November, 1936, the increases in employment, by industrial groups, were: Manufacturing, 70,000; trade, distribution, and finance, 58,000; mining, 5,000. Decreases in employment were found in: Construction 151,000; agriculture, 74,000; service, 31,000; transportation, 16,000; forestry and fishing, 5,000; public utilities, 2,000.

Compared with November, 1935, employment in November, 1936, increased 8.0 per cent in manufacturing; 27.9 per cent in construction; 8.9 per cent in transportation; 5.5 per cent in the public utilities; 4.7 per cent in trade, distribution, and finance; 3.6 per cent in the service industries; and 2.1 per cent in agriculture.

The following table prepared by the Conference Board shows the number of employed workers in the various industrial groups in November, 1935, and November, 1936.

Number of Employed Workers (in thousands)

	Nov. 1935	*Nov. 1936**
Agriculture	10,558	10,777
Forestry and fishing	151	154
Industry		
Mining	685	746
Manufacturing	9,153	9,889
Construction ..	1,688	2,159
Transportation	1,701	1,853
Public utilities	892	941
Trade, Distribution, and Finance	6,825	7,149
Service Industries	8,543	8,850
Miscellaneous Industries and Services	1,267	1,337
Total employed..	41,463	43,855

* Preliminary.

New Equipment

(Continued from page 81)

Pipe Conduit

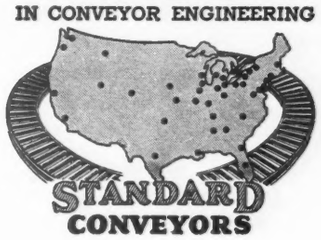
For underground steam and water lines. Consists of vitrified tile conduit made in 2-ft. lengths with bell-and-spigot joints, and supporting base tile with drain construction. Provision is made for replacement of rollers upon which pipe can be supported. American District Steam Co., North Tonawanda, N. Y.

Pumps

Line of self-priming centrifugal pumps ranges in size from 2 to 10 in. with capacities in accordance with standardized ratings. Large cases, quick priming action, built-in check valves, double grease seal, are features. The 4-in. Model 40M, 6-in. Model 75M, 8-in. Model 125M, and the 10-in. Model 200M all have impellers mounted on a sturdy shaft supported by

JUST as big city traffic requires planned handling to speed the flow of vehicles through the streets and provide safety . . . so does production traffic in your plant require planned material handling to speed production and lower costs. . . . No matter what commodities you have to handle, or how they must be carried—Standard can install conveying equipment exactly suited to your specific needs. . . . Let a Standard Engineer survey your plant and make recommendations. No cost or obligation. There's a Standard office near you—call them.

A NATION-WIDE SERVICE IN CONVEYOR ENGINEERING



STANDARD CONVEYOR COMPANY

GENERAL OFFICES: NORTH ST. PAUL, MINN.

"Conveyors by Standard"—a valuable reference book on conveyors and conveying methods. Sent free to plant and production executives.

Let the Job Choose the Caster

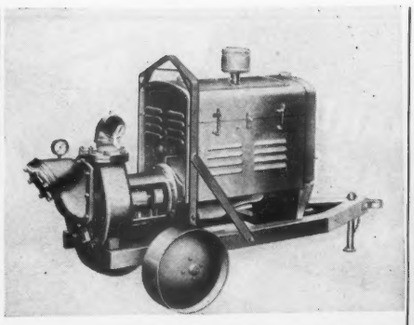
No one who wanted to do the job efficiently would use a snow shovel to dig a ditch.

129-A Series

LIKE TOOLS, casters should be selected for the job they must do. Because Bond Casters are engineered for specific uses, Bond offers a large and varied line from which to choose. For any truck job, there's a Bond Caster to smooth the way, absorb the shock, lengthen equipment life. To get the right performance, choose the right Bond Caster. Bond Catalog K-25 will help you do it. It contains important engineering data—write for a copy.

BOND FOUNDRY & MACHINE COMPANY
MANHEIM, Lancaster County, PENNSYLVANIA
617 Arch St., Phila.; 30 Church St., N. Y. C.
Bond Engineering Works, Ltd., Toronto, Can.

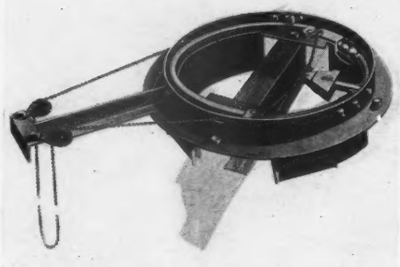
Bond REG. U.S. PAT. OFF.
TRUCK CASTERS
Bond Power Transmitting Machinery delivers more power at less cost.



two heavy-duty ball bearings. Shaft is driven through flexible coupling. Pump support bracket is bolted to engine. Sterling Machinery Corp., 411 Southwest Blvd., Kansas City, Mo.

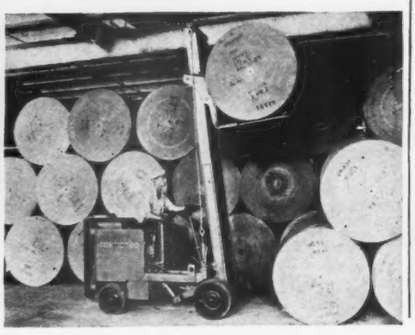
Monorail Turntables

Turntables for overhead monorails now have full floating ball-bearing construction. Running in an inclosed annular double angle ring housing, the balls take both radial and thrust loads. Main sections are made from rolled steel. Simple latching mechanism keeps turntable properly aligned with cross tracks and safety blinds prevent trolleys from running through open ends. No. 3912 has capacity of 1 ton, No. 3919 of 3 tons. Richards-Wilcox Mfg. Co., Aurora, Ill.

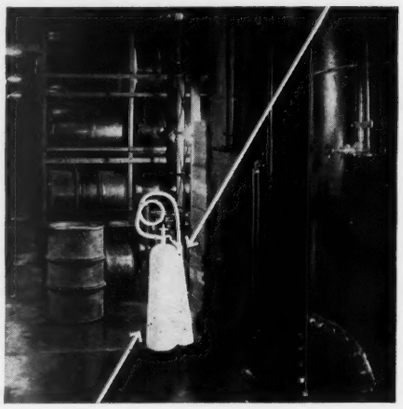


Lift Truck

High mast lift truck is especially designed for handling paper in rolls and stacking it to great heights. Rolls are taken on plate with scooping action. Mast tilts backward so that roll is held on the plate and against the mast by its own weight. When truck arrives at storage piles the mast can be tilted forward to deposit the roll. Truck operator can, with the truck, do all operations without help. Lifting and tilting are accomplished hydraulically, and the load is carried over the driving wheels. Towmotor, Inc., 1233 East 152nd St., Cleveland.



Something's MISSING HERE!



—and it means REAL FIRE PROTECTION

IT is mighty bad business policy not to guard every fire hazard. There is no economy in sparing the extinguisher and spoiling the factory.

It is equally poor safety to have the *wrong* extinguisher. Let's be specific — In the oil storage room, pictured above, carbon-dioxide protection is essential. Ordinary extinguishers are helpless before flammable liquid fires. LUX carbon-dioxide snow-and-gas snuffs them out in a few seconds . . . in a fast-expanding cloud that reaches every remotest inch of the fire area.

LUX extinguishers use the fastest known extinguishing agent, LUX carbon-dioxide snow. It is clean, dry and harmless to man or materials.

If you have flammable liquids stored in your plant, protect them with LUX extinguishers. Here is a case where anything less than LUX protection is no protection at all.

You can buy LUX fire extinguishers ranging from 2 to 100 lbs. of carbon-dioxide capacity. For information and prices, write to

Walter Kidde & Company
12 West Street Bloomfield, N. J.

LUX For All Electrical and Flammable Liquid Fires

Just off the Press!

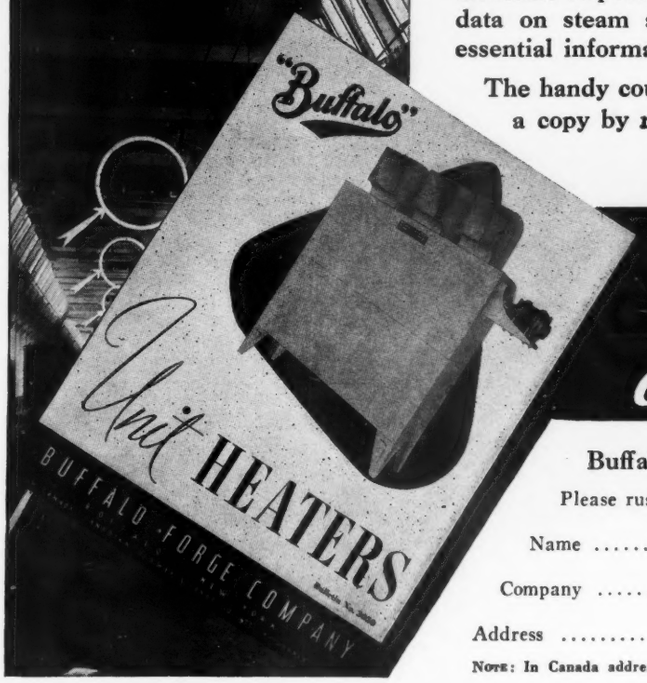
32 PAGE BULLETIN OF VALUABLE INFORMATION ON

UNIT HEATERS

WITH much cold weather still ahead, this new bulletin should be in the hands of every heating engineer, plant superintendent, contractor, and user or potential user of Unit Heaters.

Prepared by a Company whose world-wide experience in the heating, ventilating, and air conditioning field guarantees correct design and economical operation of every "Buffalo" Unit Heater, the bulletin is profusely illustrated with all types—Highboys, Lowboys, Breezo-Fin, and Gas Heaters. Contains important B. t. u. Rating Tables data on steam systems, and much other essential information.

The handy coupon below will bring you a copy by return mail.



Clip and Mail Today

Buffalo Forge Company, 471 Broadway, Buffalo, N. Y.

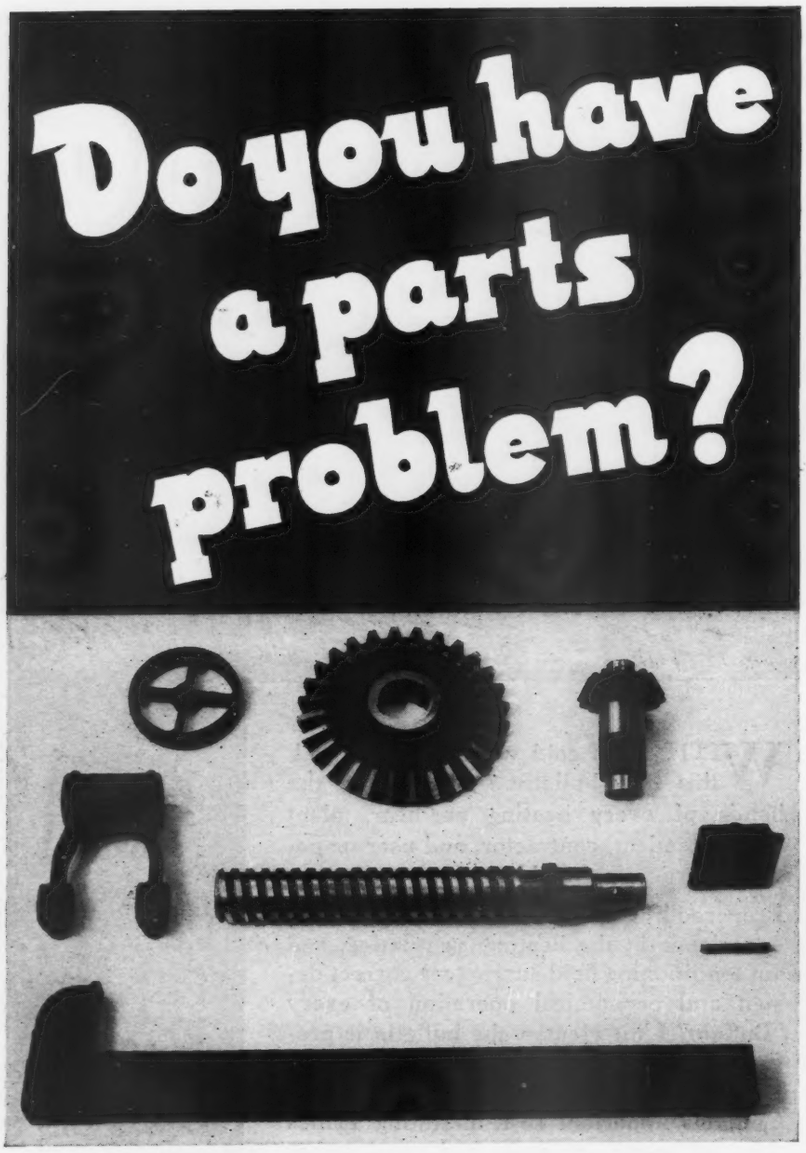
Please rush copy of your new Unit Heater Bulletin 3050 to—

Name ..... Position .....

Company .....

Address .....

NOTE: In Canada address requests to Canadian Blower and Forge Co., Ltd., Kitchener, Ont.



If your plant facilities are taxed beyond their capacity—if your production schedule is "jammed" for one reason or another—if you are behind in your orders and quick deliveries are imperative . . .

DUFF-NORTON CAN HELP YOU

Here at your service are unexcelled facilities for manufacturing . . . machining and assembling standard or special parts to your exact specifications including commercial forging, gear cutting, lathe-turning, and threaded parts of every description. ***Parts may be drop forged or drop forged and machined as specified.***

Here at the Duff-Norton Manufacturing plant is the skilled man-power as well as machinery to produce any special need you may require—in part or in volume—quickly, accurately and economically.

Take advantage of this service . . . a telephone call—a telegram or letter to Duff-Norton will start the ball rolling toward a satisfactory solution of your production problem.

Listen In—Every Friday Nite at 7:45 P. M., E.S.T.
"The House That Jacks Built"
RADIO PROGRAM
WEAF, New York; WMAQ, Chicago; KDKA, Pittsburgh
Entertainment that Engineers and Maintenance Engineers Like!

THE DUFF-NORTON MANUFACTURING CO. . . Pittsburgh, Pa.
Branch Offices in the Principal Cities

"THE HOUSE THAT JACKS BUILT"

Stainless Steel Truck

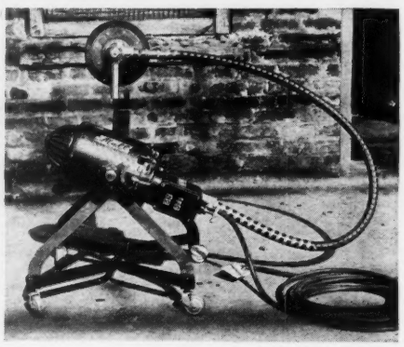
Made of stainless steel for handling wet and corrosive materials, this truck has welded sides and rolled welded edges, leaving smooth edges and corners over which delicate materials, such as fabrics, can be passed without damage. It has an inverted bottom construction providing drainage around the edge and saving the labor of upending the truck after washing. Channel steel chassis. Casters. Made in any size and weight to specifications. Stackbin Corp., Providence, R. I.

Circuit Breakers

Type F122 indoor solenoid-operated oil circuit breakers. Rated at 25,000 kva. manually; operated up to 600 amp., 7,500 volts, and 800 amp., 2,500 volts, 2- and 3-pole, single-throw. Panel frame mounting for direct control; wire, pipe, or structural steel frame mounting for remote control. Westinghouse Electric & Mfg. Co., East Pittsburgh.

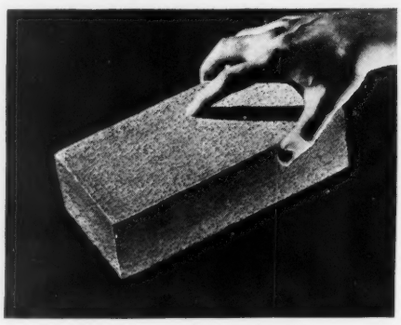
Portable Grinder

Heavy-duty flexible-shaft grinder has tri-position mounting, permitting the grinder to be used in any of three positions; as a bench grinder, suspended from overhead, or as a floor machine. Can be furnished with either 1½- or 3-hp. dustproof motor. Mall Tool Co., 7740 South Chicago Ave., Chicago, Ill.



Insulating Brick

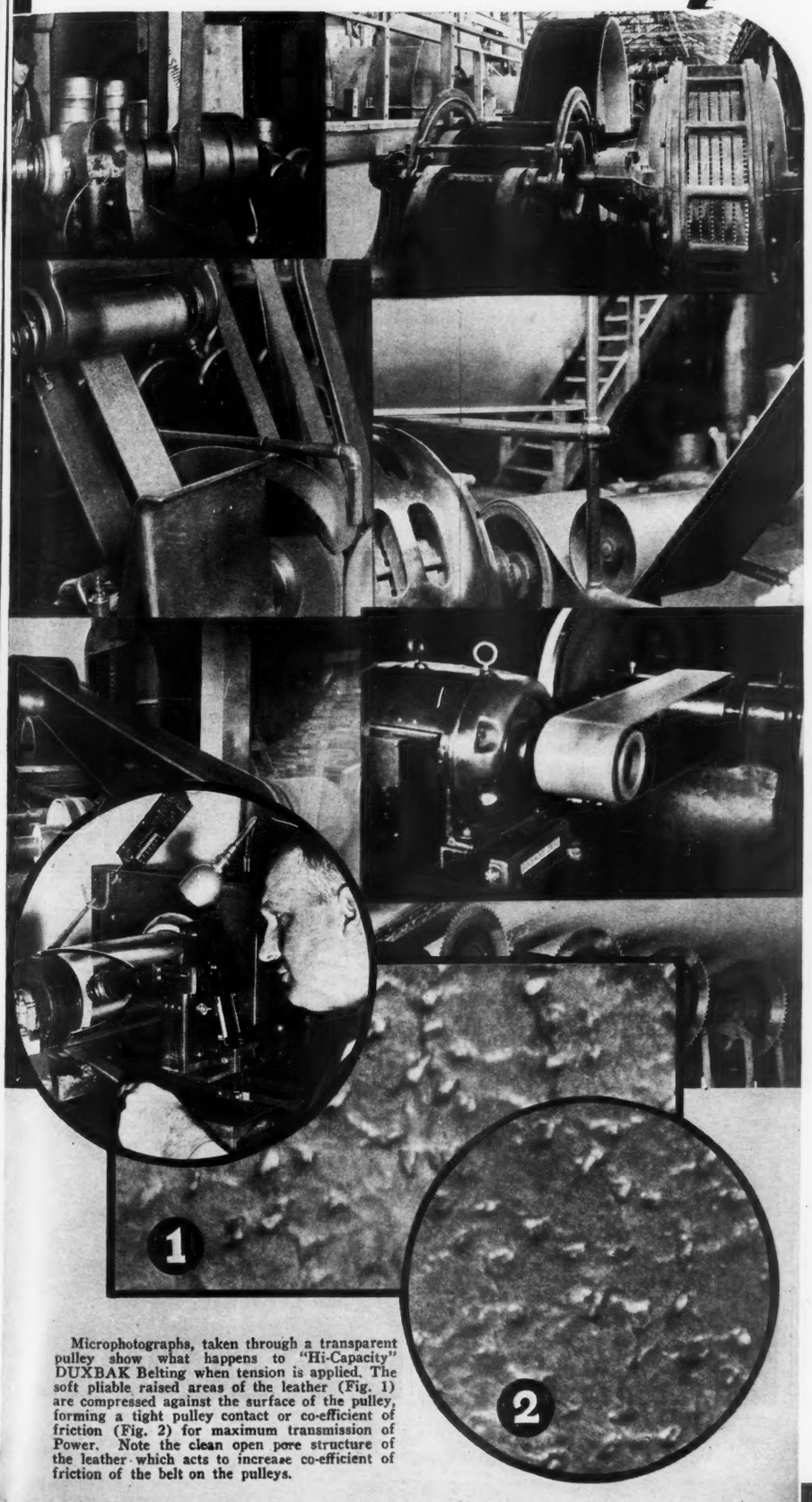
Insulating brick known as "JM-20" is designed for temperatures up to 2,000 deg. F. Intended for use behind refractory walls in high temperature equipment. Can be used for direct exposure up to 2,000 deg. wherever there is no flame impingement, slag action, or mechanical abrasion. Light in weight, its heat capacity and thermal conductivity are low. Johns-Manville Corp., 22 East 40th St., New York.



Presenting SCHIEREN'S new "Hi-Capacity"

DUXBAK BELTING

TRADE MARK



Microphotographs, taken through a transparent pulley show what happens to "Hi-Capacity" DUXBAK Belting when tension is applied. The soft pliable raised areas of the leather (Fig. 1) are compressed against the surface of the pulley, forming a tight pulley contact or co-efficient of friction (Fig. 2) for maximum transmission of Power. Note the clean open pore structure of the leather which acts to increase co-efficient of friction of the belt on the pulleys.

A scientific development that vastly improves Power Transmission

So perfect is the transmission of power with this new type, combination tanned SCHIEREN Belting that there would be practically no slippage even if pulleys were made of glass.

Achievement of such remarkable performance is the result of applying modern scientific methods to a specialized experience in the development and manufacture of leather belting which dates back nearly seventy years.

Entirely new methods of tanning, under rigidly controlled production with the most modern machinery enables Schieren to offer industry the money-saving features of "Hi-Capacity" Duxbak—exceptional pliability, low stretch, longer belt life and a higher co-efficient of friction on the pulleys—features which mean lower power costs, lower maintenance, lower production costs and improved production. These advantages have been proved in test and demonstrated in service.

Your opportunity to cut costs and speed up production lies in the extent to which you modernize your power transmission through the use of "Hi-Capacity" Duxbak Belting. Consult your nearest Schieren Branch or Distributor.

DUXBAK BELTING

Chas. A. Schieren Company

ESTABLISHED 1864

Tanners and Manufacturers of

LEATHER BELTING, PACKINGS and SPECIALTIES

Main Office and Factory:

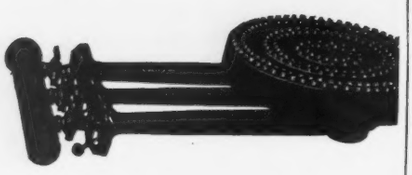
33 FERRY STREET NEW YORK

Branches and Distributors in All Principal Cities

CHAS. A. SCHIEREN CO. OF CANADA
60-62 Front St., W. Toronto, Ont., Canada

JOHNSON

Triple Atmospheric Ring Burners No. 60-BCE



Here's an outstanding burner that is used extensively in factories where direct application of heat is required. This unit is made up of three independent ring burners which may be used singly, in pairs, or in triple. Equipped with Improved Johnson Venturi Air Mixers and Tubes. Three heavy A.G.A. type valves fitted with the famous Johnson Patented Direct Jet Regulator. Sturdy, efficient and adaptable to many needs. Write for ful' details.

JOHNSON GAS APPLIANCE CO.
Cedar Rapids IOWA

Western Representative:
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WIRE

Round—Flat—Half Round Straightened and Cut Shape Wire

HIGH CARBON SPRING
LOW CARBON BASIC AND
BESSEMER OIL TEMPERED
WELDING WIRE RODS AND COILS

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Sizes ½" to No. 40 WM Gauge (.007)—All Finishes

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Wire for Practically All Purposes and Requirements also SCREEN WIRE CLOTH

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Highest Quality and Service Guaranteed

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Established 31 Years

IRON STEEL QUALITY — WIRE — "SENECA" — Trade Mark

The Seneca Wire & Mfg. Company
Fostoria, Ohio

Representatives and Warehouses in practically all principal cities

Lamp

Mazda lamp of 300-watt size is equipped with medium screw base. It is believed it will eventually replace present standard medium skirted 300-watt lamp, and probably the 200-watt type. Bulb diameter is identical with present 300-watt, but overall length is 1½ in. less than present skirted type. Can be used in most sockets where 200-watt lamps are now employed. General Electric Co., Nela Park, Cleveland.

Flow Meter

No. 49 Flow Indicator indicates rate of flow of steam, liquids, or gases through a pipe line. Works on principle of differential pressure. Pressure acts on metal bellows whose movement is transmitted through a pressure-tight bearing to the indicating pointer. Calibration is obtained by changing length of link arm. Face of instrument is 4¼ in. in diameter, and bellows and dial case are built in compact unit. Made of cast bronze for panel or wall mounting. For working pressures up to 500 lb. per sq. in. Morey & Jones, Ltd., 922 South Hemlock St., Los Angeles.

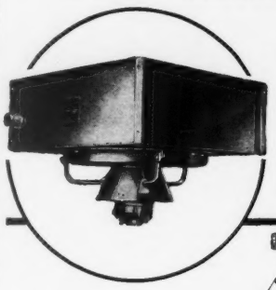
Stock Cart

Designed to speed up order filling and stock handling, this cart is equipped with four large rubber-tired casters. Front casters are swivel, rear are stationary. Dimensions are: 32 in. high, 30 in. long, and 16 in. wide, making it a handy size for use in aisles between storage bins. The two shelves are 3 in. deep, and a third shelf can be added if desired. Finished in green enamel. Lyon Metal Products, Inc., Aurora, Ill.

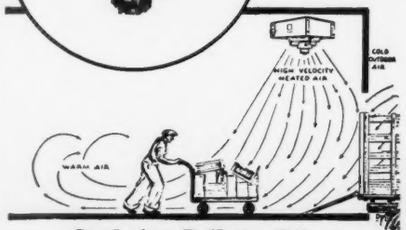
HEAT THE COLD AIR THAT BLOWS IN THE DOORWAYS

There is a simple, positive and inexpensive means of accomplishing it.

WING TYPE G DOOR HEATERS–



are designed specifically to overcome the health hazards, waste and discomforts of these hard to heat areas.



Send for Bulletin G-1.

FOR SMALLER DOORS–

you will find the

WING KILDRAFT

a most unusually effective heater to warm the usual inrush of cold air.

Send for Bulletin KD-1.

L. J. WING MFG. CO.
162 W. 14th St. New York, N. Y.

WING
WING
DOOR HEATERS

"A.W." ROLLED STEEL FLOOR PLATE

Whatever your problem in floor covering may be, there is a pattern of "A.W." Floor Plate to solve it.

1. "A.W." Super-Diamond pattern is the most efficient for general use. Provides a completely safe tread from every possible angle and under all conditions.

2. "A. W." Standard Diamond pattern is required for unusually heavy duty — where large, high projections are of advantage.

3. "A. W" Diamondette pattern is designed for small wheel trucking of light and medium loads, and pedestrian traffic. It is practically noiseless.

Write for new literature illustrating and describing five "A.W." Floor Plate patterns and giving full engineering data.

ALAN WOOD STEEL COMPANY

CONSHOHOCKEN, PA.

BRANCHES: Philadelphia, Pa., Fidelity-Philadelphia Trust Bldg.—New York, N. Y., 60 E. 42nd Street—Boston, Mass., 250 Stuart Street—Detroit, Mich., 3729 Crane Ave.—Los Angeles, Cal., 620 W. M. Garland Bldg.—San Francisco, Cal., 444 Market Street — Seattle, Wash., 401 Polson Bldg. — Houston, Texas, 110 Byrne Street.

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ALAN WOOD STEEL CO. ESTABLISHED 1826 TRADE "A.W." MARK CONSHOHOCKEN, PA.

111 YEARS' IRON AND STEEL-MAKING EXPERIENCE

*PHOTRONIC
Light Beam Control
for practical factory operations

Built to practical factory standards of simplicity, dependability and ruggedness

The WESTON Model 729
Industrial Control Relay

Operating speed 400 per minute . . . Meter on panel indicates whether light beam on cell is adequate.

Required light intensity on photo-cell only 100 foot-candles . . . Output capacity of relay 500 watts.

With WESTON PHOTRONIC light beam control, only the compact and rugged PHOTRONIC Cell . . . entirely free from moving or delicate parts . . . need be mounted at the point of operation. The cell is simply wired to the relay box which can be located at any convenient point; far removed from the cell, if necessary. No amplifying or other auxiliary equipment is used, for the lifetime PHOTRONIC Cell generates sufficient energy to directly operate the relay unit. Thus PHOTRONIC control is simple, flexible and highly practical . . . which explains its widespread use for controlling conveyors, counting objects, turning valves, operating cutting knives . . . and for countless other factory operations where complete practicability and overall economy are twin requirements.

Perhaps your plant operations, too, involve control problems in which the "make and break" of a light beam is the simplest way to quick and positive response. Why not check this possibility with WESTON engineers . . . or, send for literature on Model 729 . . . Weston Electrical Instrument Corp., 628 Frelinghuysen Ave., Newark, N. J.

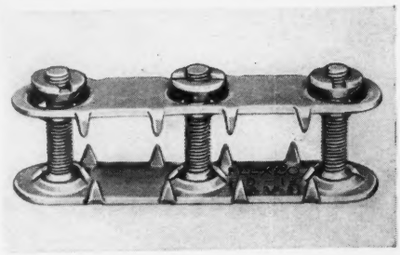
WESTON *Instruments*

*PHOTRONIC—a registered trademark designating the photoelectric cells and photoelectric devices manufactured exclusively by the Weston Electrical Instrument Corporation.

Truck

Pneumatic-tired flat truck. Suitable for use by millwrights, electricians, and other maintenance men who must move their equipment about the plants. Tires permit its moving over rough ground and obstructions. It can be turned in a short radius. Wheels are equipped with ball or roller bearings. Saginaw Stamping & Tool Co., Saginaw, Mich.

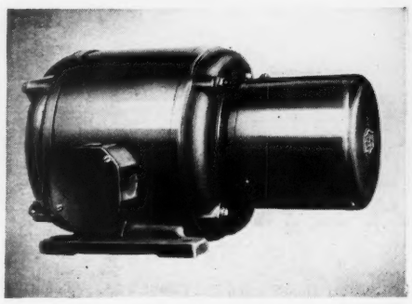
Conveyor Rip Plate



"Flexco Rip Plate" is designed for use in repairing rips or breaks in conveyor belting. It consists of upper and lower plates with protecting teeth which grip belt on either side of rip. A bolt and nut assembly passing through both plates and the belt holds the parts together. For a weak spot, a section of the belt can be cut out, replaced with a patch secured by several of these plates. On belts passing over pulleys less than 5 ft. in diameter, it is advisable to use the plates only for longitudinal rips. Flexible Steel Lacing Co., 4607-31 Lexington St., Chicago.

Motor Brake

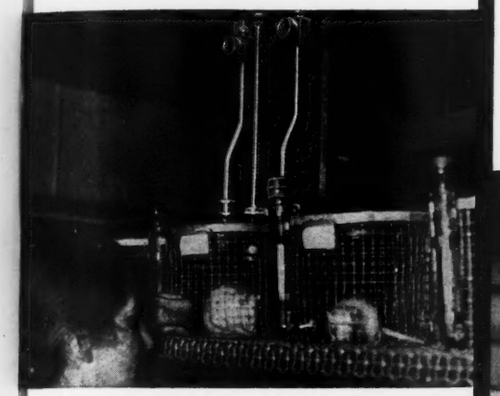
Totally inclosed, automatic solenoid brake is mounted integral with motor. For motors from fractional horsepower to 10 hp. at 3,600 r.p.m. Rotating member, a



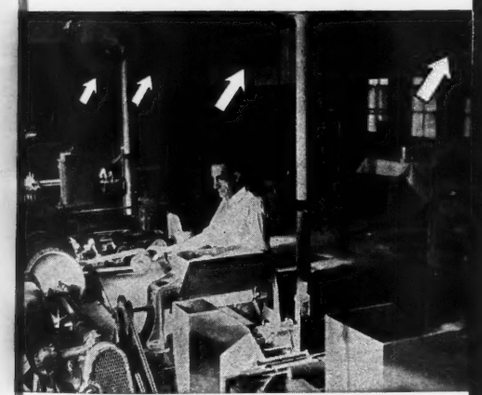
Carrier Air Conditioning

CUTS OPERATING COSTS Protects Lab Tests...

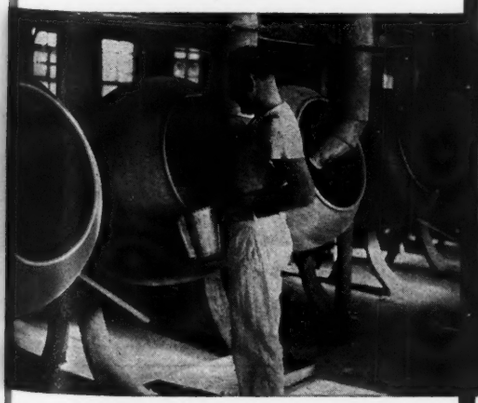
1 Household Words in a million homes, Feen-a-Mint and Aspergum manufactured by Health Products Corp., of Newark, N. J., owe much of their purity and quality to Carrier Air Conditioning.



2 Lucky Rats live in atmosphere controlled as carefully as in the Capitol at Washington, to make feeding tests accurate and avoid variations caused by constantly changing weather conditions.



3 Shut Down? Never! No matter how high the temperature or how great the humidity outside, Carrier Air Conditioning keeps the rolling and scoring department running full speed.



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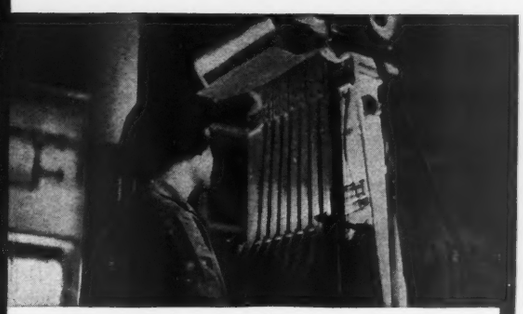

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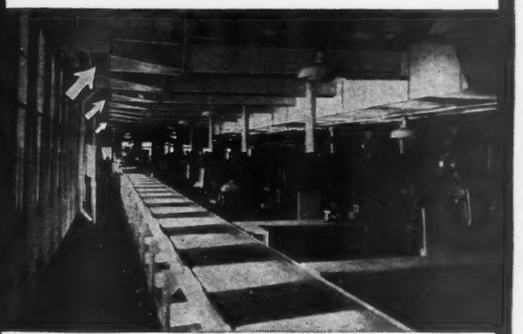
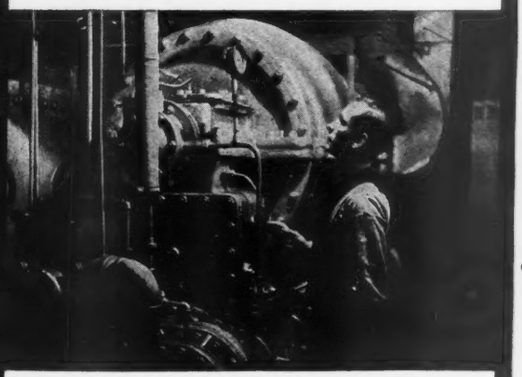


6 Look Up and you'll see the ingenious ducts which deliver the dehumidified air to the packing room, keep packaging machinery operating smoothly and employees at top efficiency, regardless of outside weather.



7 Everything O. K., plant engineer Norman Smith inspects one of the Carrier Centrifugal Units which has provided air conditioning continuously since first installed—15 years ago.

It pays to Install Carrier Air Conditioning NOW

NAME any industry — in any country — and you're likely to find Carrier Air Conditioning on the job. Reducing operating costs. Speeding production. Improving products and increasing the efficiency of employees. It *pays* to have Carrier Air Conditioning. And Carrier engineers—with more than 25 years' exclusive experience in air conditioning such famous plants as Knox Gelatine, Whitman's Candy, buildings like Macy's, crack railroad trains and ocean liners—can install an air conditioning system to meet any needs. Remember, Carrier *invented* air conditioning.*

Steal a march on the weather by calling the Carrier man today. Learn how Carrier Air Conditioning can be installed in your plant *now* while making annual plant revisions — without interrupting daily operations.

He Invented Air Conditioning..

*In 1911—more than 25 years ago, Willis H. Carrier disclosed the Carrier Law of Air Conditioning to the American Society of Mechanical Engineers, made the first installations.

PHOTOGRAPHS EXCLUSIVELY FOR CARRIER CORP. BY WALTER ENGEL, PICTURES, INC.

CARRIER CORPORATION, Desk 208,
850 Frelinghuysen Avenue, Newark, N. J.

Without obligation, send me complete information on Carrier Air Conditioning for .....plant.

NAME.....

ADDRESS.....

CITY.....STATE.....

Built to practical factory standards of simplicity, dependability and ruggedness

The WESTON Model 729
Industrial Control Relay

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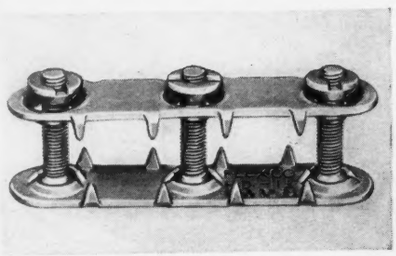

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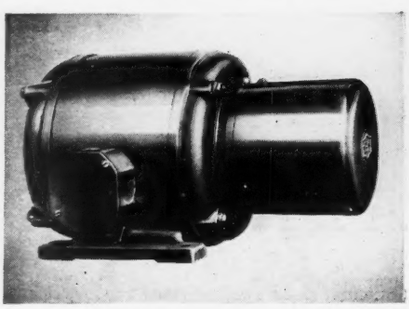

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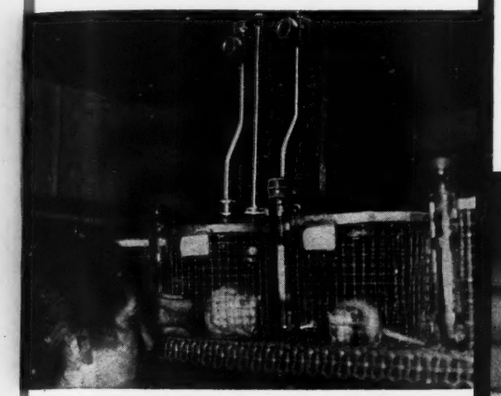

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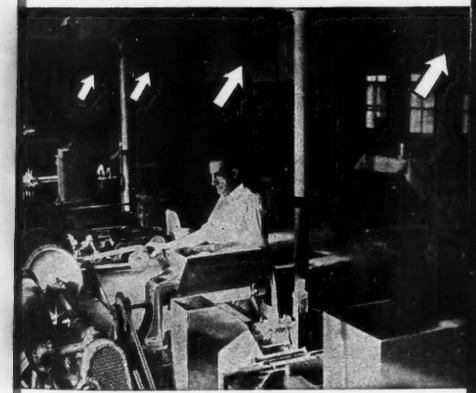

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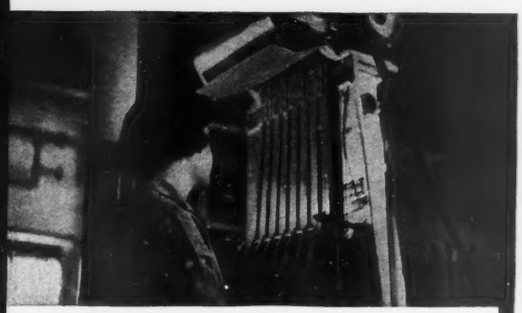
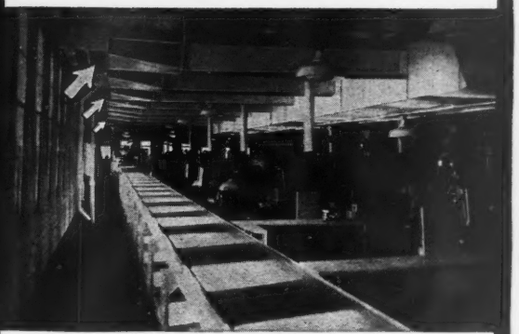
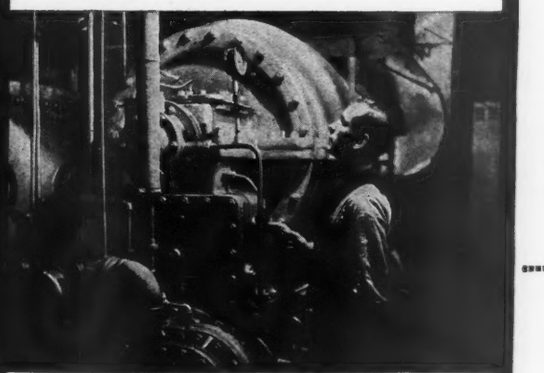


5 Pop! Pop! Pop! a steady stream of the finished gum pellets—still protected from heat and humidity by Carrier Air Conditioning—passes through this all-but-human machine, is packaged, wrapped in Cellophane.



6 Look Up and you'll see the ingenious ducts which deliver the dehumidified air to the packing room, keep packaging machinery operating smoothly and employees at top efficiency, regardless of outside weather.



7 Everything O. K., plant engineer Norman Smith inspects one of the Carrier Centrifugal Units which has provided air conditioning continuously since first installed—15 years ago.

It pays to Install Carrier Air Conditioning NOW

NAME any industry — in any country — and you're likely to find Carrier Air Conditioning on the job. Reducing operating costs. Speeding production. Improving products and increasing the efficiency of employees. It *pays* to have Carrier Air Conditioning. And Carrier engineers—with more than 25 years' exclusive experience in air conditioning such famous plants as Knox Gelatine, Whitman's Candy, buildings like Macy's, crack railroad trains and ocean liners—can install an air conditioning system to meet any needs. Remember, Carrier *invented* air conditioning.*

Steal a march on the weather by calling the Carrier man today. Learn how Carrier Air Conditioning can be installed in your plant *now* while making annual plant revisions — without interrupting daily operations.

He Invented Air Conditioning..

*In 1911—more than 25 years ago, Willis H. Carrier disclosed the Carrier Law of Air Conditioning to the American Society of Mechanical Engineers, made the first installations.

PHOTOGRAPHS EXCLUSIVELY FOR CARRIER CORP. BY WALTER ENGEL, PICTURES, INC.

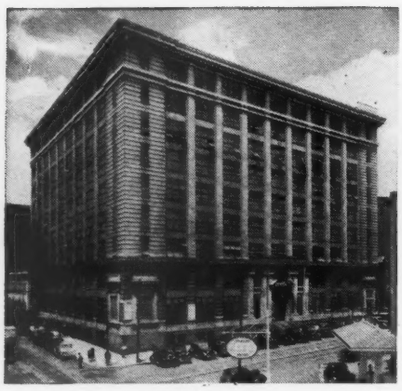
CARRIER CORPORATION, Desk 208,
850 Frelinghuysen Avenue, Newark, N. J.

Without obligation, send me complete information on Carrier Air Conditioning for .....plant.

NAME.....

ADDRESS.....

CITY.....STATE.....



Sonneborn Industrial Building, Baltimore, Md.

INDUSTRIAL BUILDING GETS MODERN HEATING

Steam Circulated with Maximum Effectiveness after Webster Heating Modernization

HEATED BY DISTRICT STEAM

Baltimore, Md.—The Sonneborn Industrial Building's well-planned modernization program was carried one step further during the 1935-36 heating season by the installation of the Webster Moderator System of Steam Heating.

This large industrial building is under the management of F. N. Iglehart & Co., Inc. Modernization of the heating system has made it possible to provide more efficient service by circulating steam with maximum effectiveness.

All of the factors that make the Sonneborn Building's heating problem unique were carefully considered by Webster Engineers, who stayed on the job until the installation was completely satisfactory.

An Outdoor Thermostat automatically adjusts the supply of steam with every change in temperature, sun effect and direction and velocity of the wind. The system also compensates for the stack effect of the building, the skylight influence on the top floor and excessive air changes on the first floor adjacent to the shipping platform.

Although Webster Moderator Control has been in use less than one complete heating season, the owners of the Sonneborn Building are confident that maintenance of uniform room temperatures will increase the health and efficiency of building occupants and effect a substantial reduction in heating cost.

The Sonneborn Building is heated by district steam. The combination of district steam service and the Webster Moderator System gives this large industrial building one of the most modern heating installations in the city of Baltimore.

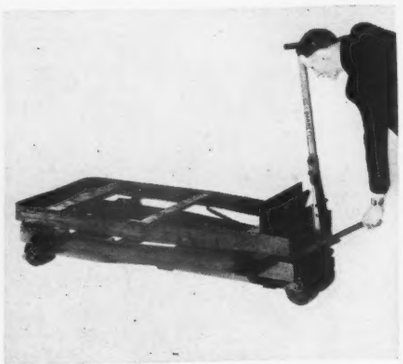
In the Sonneborn Building, as in many large buildings, the heating problem was solved by retaining the existing plant, modernizing or replacing out-of-date equipment and applying effective Webster central controls.

If you are interested in heating *new* buildings, or in improved heating service and lower heating cost in your present building, address WARREN WEBSTER & CO., Camden, N. J. Pioneers of the Vacuum System of Steam Heating Branches in 60 principal U. S. Cities — Estab. 1888

heavy molded disk, resists wear well and is protected from dirt and damage by inclosing case. Brake is for a.c. or d.c. and comes in dust, weather, and watertight inclosure. Pleasing design is in harmony with modern trend in self-contained units. Cutler-Hammer, Inc., 253 North 12th St., Milwaukee.

Lift Truck Frame

Auxiliary frame for hand lift truck is designed to handle skids varying in underneath clearance. When mounted on truck 6 in. high in lowered position, skids with underneath clearance of 6½, 7½, 9½ and 10½ in. can be handled. When mounted



on 7-in. high truck it will handle skids with clearance of 12 in. Operated by pulling of auxiliary handle until frame is brought up snug under skid. Ratchet holding device keeps it in place. To lower frame, a slight kick on release bar does the trick. Barrett-Cravens Co., 3255 West 30th St., Chicago.

Arc Welder

Low-range d.c. welder utilizes rectifier tubes instead of rotating equipment. Is designed to operate on 3-phase, 50- or 60-cycle power, 230, 440, or 550 volts, using four mercury-Tungar bulbs. Can be used for welding light gage metal. Has 25-75 amp. current range, controlled by 9-point tap switch. Is light in weight and mounted on hard rubber castings. General Electric Co., Schenectady, N. Y.

Electrode

"Murex Type" coated electrodes for arc welding. Suitable for bridging gaps where fit-up between plates is poor. Deposited metal is said to have tensile strength of

(Continued on page 102)

Saves Time Saves Accidents

Every Dayton Safety Ladder in your plant serves a double purpose. Saves workman's time, saves accidents. No wabbling, no tipping, both hands free for fast work. Made of durable airplane spruce, strongly braced. Sizes 3 to 16 feet. Gives you quality at a moderate price.

(Made in Cincinnati)

Write Dept. FMM-2 for details.

•

THE DAYTON SAFETY LADDER COMPANY
121-123 West Third St.
CINCINNATI, OHIO

•

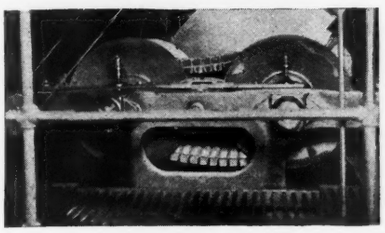
DAYTON Safety Ladder

(Patented)

Send for our new Catalog No. 5 showing a complete line of accident prevention equipment.

Dependability OF REEVES UNITS PROVED BY THE *Tough* JOBS

★ HUNDREDS OF EXAMPLES LIKE THESE CAN BE CITED SHOWING EFFICIENCY AND DURABILITY OF REEVES TRANSMISSIONS

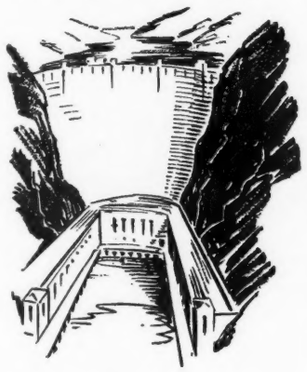


. . . 25 YEARS IN SERVICE

IN 1912, engineers at the Waterside Station of the New York Edison Company installed a REEVES Variable Speed Transmission to control stoker speeds. So accurately and efficiently did this REEVES unit regulate the rate of coal feed to combustion chamber to meet varying steam load requirements that *thirteen more* REEVES *Transmissions were installed during the next three years.*

All fourteen of these REEVES units have been in service ever since. And what exacting, continuous service! Twenty-four hours a day, every day of the year, with only ordinary maintenance and repair! Instant, accurate speed adjustability is provided over a 4:1 range, giving speed variations on stoker shaft from .044 to .177 r. p. m.—regulating coal feed to ounces of coal per hour.

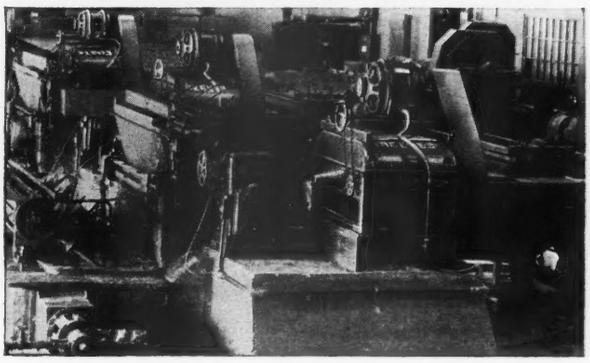
. . . A BIG JOB WITH UNCLE SAM



Huge pipe lengths for the great Boulder Dam were machined on a special boring mill regulated through a REEVES Variable Speed Transmission. This mill was in operation day and night—for more than three years. Pipe ranging in diameter from 8½ to 30 feet—over 50,000 tons of it—was built at the site of the Dam. Speed of the boring mill had to be varied because of different pipe diameters, slower speeds being necessary on the larger sizes. The REEVES unit permitted any speed from 16 to 80 feet a minute for machining seams and joints. Extreme precision in machining was required, because seams were welded and pipes joined under extremely difficult conditions—in deep, underground tunnels.

. . . TIN POT FEEDS—NEW ACCURACY

Three new tin pots at Empire Sheet & Tin Plate Co., Mansfield, Ohio, are each driven at adjustable speeds through



REEVES Variable Speed Transmissions, operating 24 hours a day. While giving instant changes in feed roll speed as required by differences in gauge of sheets, these modern, enclosed design REEVES Transmissions maintain absolute *positiveness* in a given roll speed—without fluctuation. Result: minimum number of wasters at the inspection table PLUS higher production rate than ever before obtained.

. . . WHITTLING DOWN PLANT COSTS IN OHIO

Six REEVES Variable Speed Transmissions equipped with Electric Remote control, have helped establish enviable records for efficiency, low costs and continuity of service in the Mahoningside plant of the Ohio Public Service Co., Warren, Ohio. The REEVES units, installed on 11 retort Taylor stokers with coal capacities of 6000 lbs. per hour, are operated 24 hours a day for periods of 5 to 6 weeks. Then the *stokers* are shut down temporarily for cleaning and necessary repairs. The Transmissions, operated for 5 years under these severe conditions, have required no maintenance expense whatever.

Mail this coupon for FREE copy of "Speed Control at Work."

REEVES PULLEY COMPANY, COLUMBUS, IND.

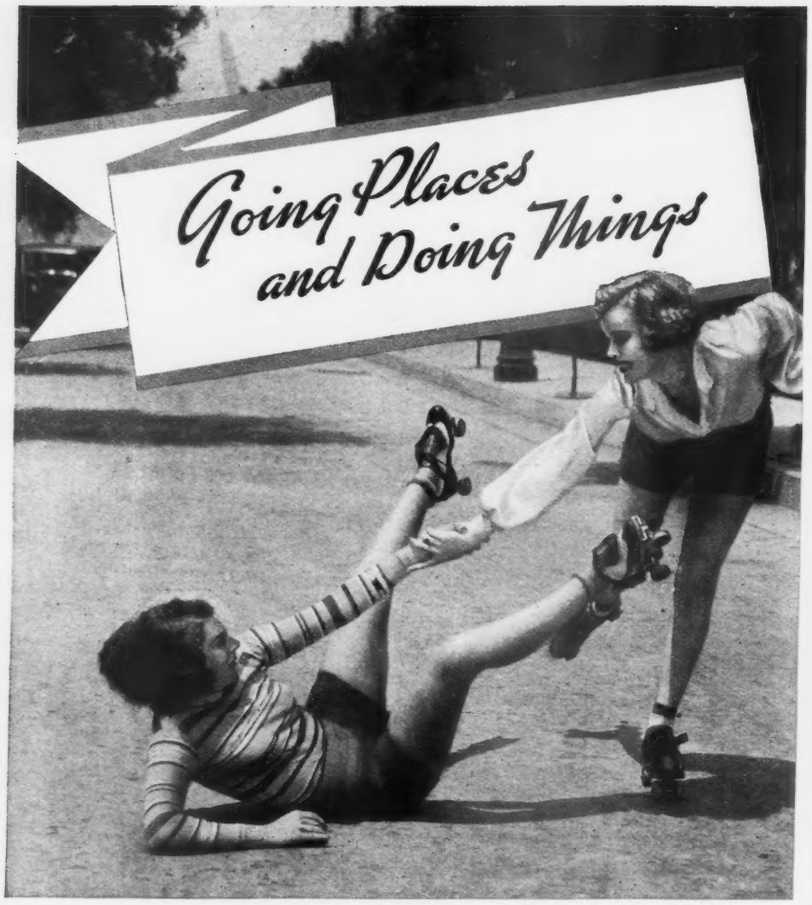
Send, without obligation, information on how 12 nationally-known plants use variable speed control, as contained in new 32-page booklet.

Name.....

Company.....

Address.....

F-2-37

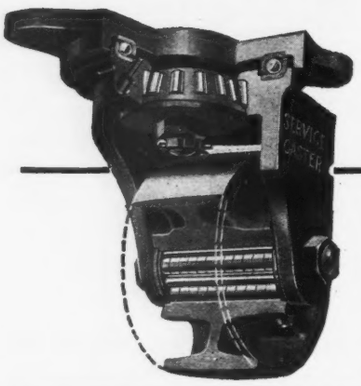


"Let's get rolling . . . out of the way moss gatherers!" That's today's theme song . . . in industry as well as in play. For 1937 America is on the move!

In times like these you need materials hauling equipment that's able to keep going at top speed . . . no matter how hard the bumps or how punishing the loads. And, that's the action you'll get from ever-young Service Trucks and Casters.

Service Trucks and Casters stay young . . . keep down maintenance costs . . . because shocks are divided over hundreds of small, smooth surfaces in Timken thrust bearings, hard, steel ball-bearings in machined steel races, and Hyatt roller bearings.

Try the rejuvenating time and money-saving action of a set of sturdy, frictionless Service Casters . . . Or, replace aging equipment with Service Trucks. Write today for complete information.



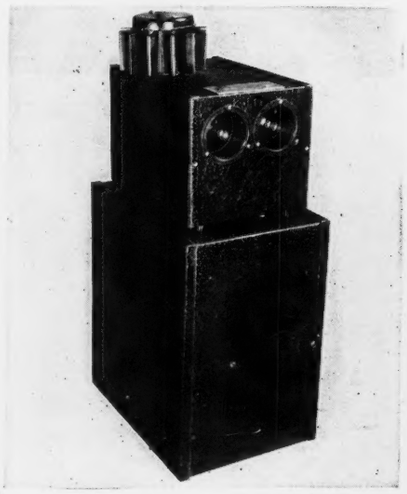
THE SERVICE CASTER AND TRUCK COMPANY
519 BROWNSWOOD AVENUE
ALBION, MICH.

Service
CASTERS & TRUCKS

74,000-84,000 lb. per sq. in., with 26-24 per cent ductility. For d.c. or a.c.; may be used with straight or reversed polarity. Metal & Thermit Corp., 120 Broadway, New York.

Photoelectric Control

The "Teletouch Ray" combines light source and photoelectric cell in one unit. Light from 200-watt bulb in the unit passes through one window and is focused on a fixed surface from which it is reflected

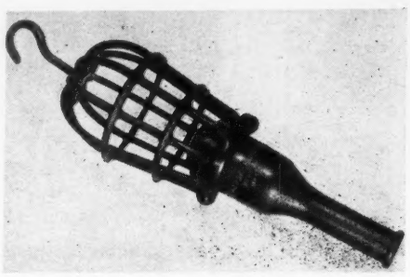


to the cell. As the beam is interrupted, amount of light reaching the cell is diminished. Amplifier at base of unit operates relay. Unit may be plugged into any a.c. outlet. Teletouch Corp., 37 West 54th St., New York.

Pulley Surfacing

Designed to improve belt drive efficiencies, this waterproof, specially processed fabric is cemented to pulley. Quick-drying cement is applied to pulley surface and allowed to dry a short time. Then fabric with underside coated with cement is placed on the pulley. A final cement coating is then given to the exposed surface of the fabric and allowed to dry. Gripwell Mfg. Co., 105 West 40th St., New York.

Lamp Guard

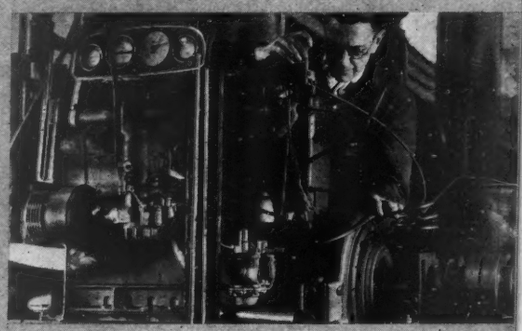


All-rubber "Shokpruf" insulated portable lamp guard. Has rubber handle and rubber-socket combination, with no metal exposed at any point. Has heavy steel guard covered with 1/12 in. of rubber. Takes 60-watt size lamp. Handle is designed for all sizes of rubber portable cords up to and including ½-in. diameter. Point of entry of cord is designed for watertight closure. Frank W. Morse Co., 301 Congress St., Boston, Mass.

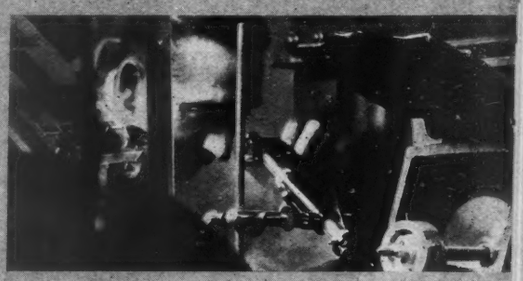
SO THAT MACHINES MAY LAST LONGER • PERFORM BETTER • OPERATE MORE ECONOMICALLY

How can better lubricants be made for the great steam turbines that supply light and power for the nation? In this apparatus, turbine oil, mixed with water, is circulated rapidly with a stream of oxygen whipped thoroughly into it. Many oils have been treated with this instrument. None has shown stability equal to Gulfcrest Oil.

How high a load can a gear tooth stand without scuffing? This instrument measures the extreme pressure characteristics of a lubricant—an important property in lubricating gears with small areas of contact and high rubbing speeds.



An 8-cylinder automotive engine on the test dynamometer to determine the wear life, horsepower output, carbon formation and friction losses due to differences in characteristics of the various lubricants used in the test.



A new machine developed by Gulf engineers—the first that will test any type of bearing under precisely the operating conditions of actual service. It measures accurately friction, torque, temperature, wear and film thickness.

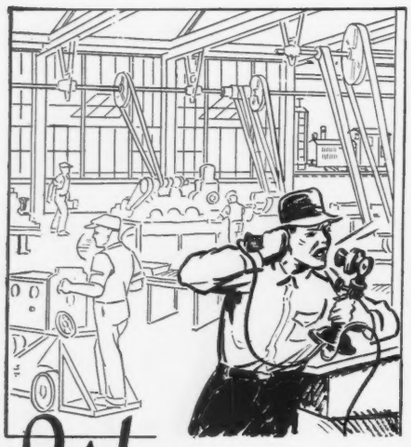
GULF RESEARCH IN LUBRICATION

● Last year, the ravages of friction cost American industry more than two billion dollars. Despite the great advances made in the science of lubrication, millions of dollars must be spent each year for maintenance of industry's costly machines.

To help manufacturers save at least a part of these huge losses—that is the prime purpose of Gulf research in lubrication. Each day, in the Gulf Research Laboratories, a large staff of qualified technologists works to perfect better lubricants—to discover new methods by which oils and greases of greater endurance can be made.

Their laboratory findings—supplemented by 37 years of practical experience in lubrication—are being converted into operating benefits by Gulf engineers in scores of industrial plants. The result—to users of Gulf lubricants—is lower costs for power, maintenance and lubrication.

GULF OIL CORPORATION GULF INDUSTRIAL LUBRICATION **GULF REFINING COMPANY**



Why let noise interfere with your telephones?

Use a BURGESS Acoustic Booth

Burgess Model 201 Booth for noisy mills and factories.

Distracting noises, caused by running machinery, factory trucks, and other industrial activity, always interfere with telephones.

There is only one way to stop such interference—install a Burgess Acoustic Booth. It has no door, yet its amazing lining of Burgess Acousti-Pad blots up factory noises so effectively that telephone conversations are easily possible in any mill or factory.

Hundreds of Burgess Acoustic Booths are in use in every industry from steel to textiles and from newspaper rooms to radio stations. One trial will convince you that a Burgess Booth in your plant will save time and money. Send for special trial offer, todav. Mail the coupon!

Licensed under C. F. Burgess Laboratories, Inc., Patents

Clip this coupon NOW!

Burgess Battery Co., Dept. F
111 W. Monroe St., Chicago, Ill.

Please send bulletin and trial offer on Burgess Acoustic Communication Booth

Name .....

Address .....

.....

Temperature Controls

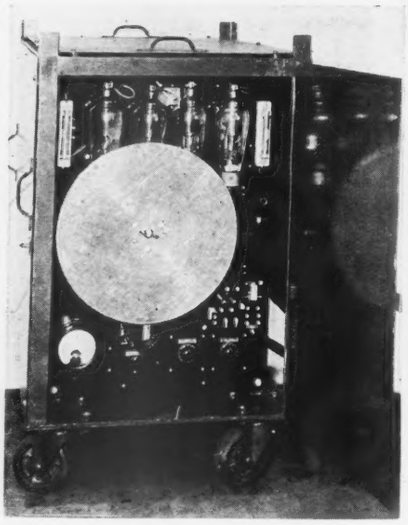
Line of temperature controls. All types have bimetallic element which actuates unbreakable switch. Switch case is metal sheathed in molded plastic and finished in crackled lacquer. Jefferson Electric Co., Bellwood, Ill.

Plating Solution

"Wite Brass" gives non-tarnishing finish which is said to be extremely white. The plating process is said to be easy to control, and no buffing of the plated work is required. Deposit is made at the same rate as with an ordinary nickel solution. Plating can be done on any metal surface. Alrose Chemical Co., Providence, R. I.

Welder Control

Seam welder control utilizes ignition tubes and times power impulses in terms of a definite number of power cycles to a



wheel-type electrode resistance welding machine. Has inductive timer consisting of a synchronous-driven disk rotating once per second and containing 120 holes, each corresponding to a half cycle of welding current. Steel pins are plugged into the holes according to the timing desired. Use of ignitron tube permits a design using no voltages higher than line voltages. Especially suited to the welding of heavy-gage steels and special alloys demanding accurate timing and heavy current. Westinghouse Electric & Mfg. Co., East Pittsburgh.

•

TRADE LITERATURE

Air Heater—Booklet, describing automatic, coal-fired air heater.—James Campbell Smith, Inc., 16374 Euclid Ave., Cleveland.

Ammeters—Bulletin, on Dual Range Clip-On ammeters.—Ferranti Electric, Inc., 30 Rockefeller Plaza, New York.

Battery Handling—Bulletin No. 205, on equipment for handling batteries quickly and easily.—The Electric Storage Battery Co., Allegheny Ave. and 19th St., Philadelphia.

Blower—Folder, on type CS Motorblower.—Ingersoll-Rand, 11 Broadway, New York.

Do you realize that every foot of combustible wiring in your plant is a potential fire hazard and could be the cause of just such a news item as pictured above? When a short circuit occurs in inflammable wiring the arc ignites the insulation and the flame tends to travel along the wire—and who can say that the resulting damage will not run into headline figures?

This is impossible with Rockbestos wire because Rockbestos insulation cannot burn or transmit flame!

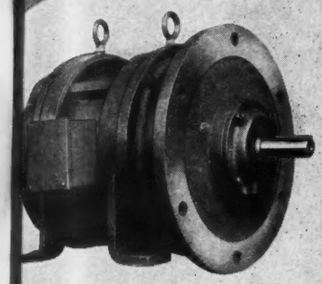
But in many plants the fact that Rockbestos wire is fireproof is of less importance than its heatproof qualities. A number of wires are "flame resistant" but Rockbestos, in addition to its fireproof qualities, is also genuinely heatproof and remains permanently so under the attack of high temperatures without flowing, swelling, or becoming hard and brittle.

Rockbestos A.V.C. Boiler Room Wire

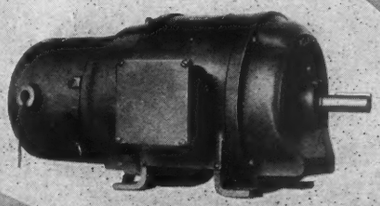
In making Rockbestos insulation, asbestos is impregnated with a neutral compound and formed into a dense felted wall. This wall is highly resistant to heat, oil, grease, acid fumes and moisture . . . it is as nearly non-deteriorating as wire insulation can be . . . and it makes Rockbestos what it is . . . the best wire to use where severe conditions prevail.

Rockbestos insulated wires and cables are available in over 50 different types, each designed for a particular use. Samples and our new No. 10-D catalog are available on request. Just drop a line to Rockbestos Products Corporation, 839 Nicoll St., New Haven, Conn.

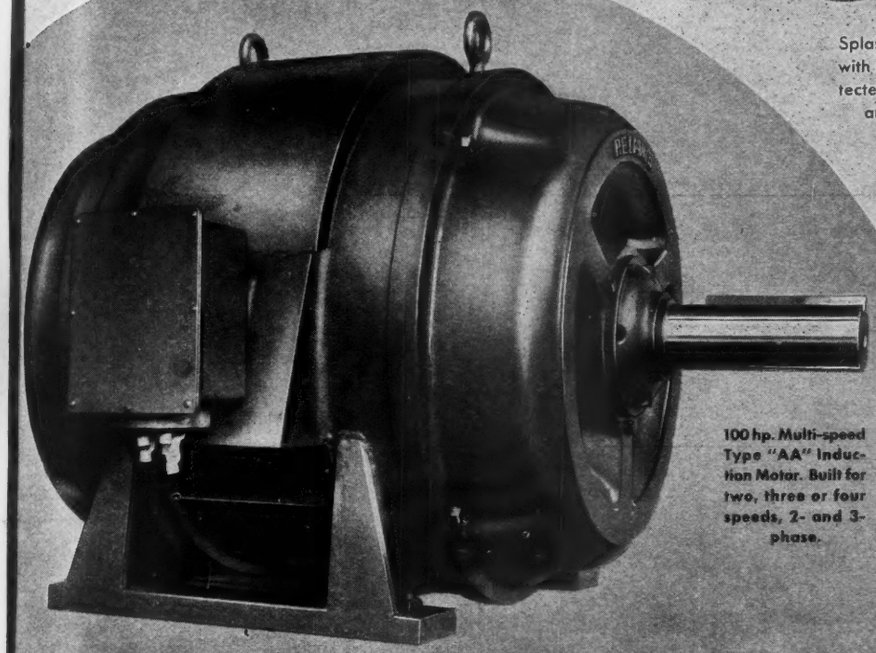
ROCKBESTOS
the wire with permanent insulation



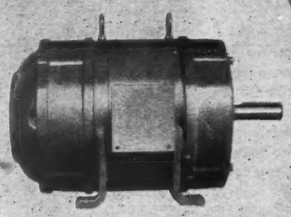
Flange-type squirrel-cage motor built with or without feet.



Splash-proof Type "AA" Motor with magnetic brake. Motor is protected against splashing liquids and dirt falling from above.



100 hp. Multi-speed Type "AA" Induction Motor. Built for two, three or four speeds, 2- and 3-phase.



Enclosed, fan-cooled motor designed for high starting torque, low starting current, normal slip. For loads such as mixers, large compressors and conveyors started under load.

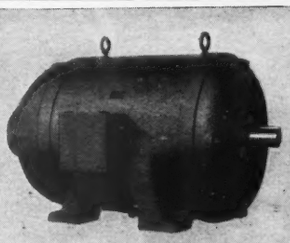
SPECIAL-PURPOSE A-c. SQUIRREL-CAGE RELIANCE MOTORS

RELIANCE Squirrel-cage Induction Motors are taking over more jobs every day. They are invading fields of application usually thought of as belonging strictly to direct-current or wound-rotor motors. They are also being supplied in such forms as to do some of their accustomed jobs better. . . . These improvements in form and operating characteristics are cutting down initial equipment costs, simplifying control and reducing maintenance. The ability to control speeds without gear changes; to start, reverse and stop quickly without clutches, is bringing definite betterments in production and quality in various industries. . . . Deciding when and how to take advantage of these advances involves special consideration of operating conditions and requirements. We shall be glad to tackle some case with you. There's no obligation in testing our ability to render a helpful service.

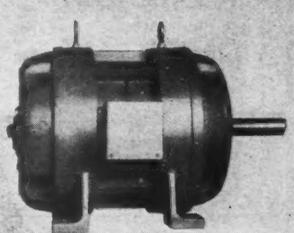
RELIANCE ELECTRIC & ENGINEERING COMPANY

1088 IVANHOE ROAD CLEVELAND, OHIO

Branches: Boston, Buffalo, Chicago, Cincinnati, Detroit, Greenville, (S. C.), New York, Philadelphia, Pittsburgh. *Representatives in other principal cities*



Low-inertia, special-torque fan-cooled motor designed for quick acceleration, quick stopping, frequent and rapid reversing.



Squirrel-cage motor for heavy presses and other flywheel applications. Has high starting torque, low starting current.

RELIANCE A-C D-C MOTORS

THE TIME TO GET STARTED IS *NOW*

Air Conditioning for Next Summer
Requires Your Immediate Attention!

1937 will be air conditioning's biggest year! We base this prediction on present activity in our own organization, and on reports received from throughout the industry.

And so we urge immediate action, if you intend to cool and condition your offices, a department or entire plant next summer. Many were disappointed last summer by not having their installations operating on time. Many more may be "out of luck" this year, unless they GET STARTED NOW. Consult your architect or engineer in regard to Clarage Air Conditioning, or write us for a definite equipment schedule to meet your particular needs. A Clarage recommendation ALWAYS includes exclusive advantages which insure satisfaction with UTMOST ECONOMY.

SPECIFY CLARAGE for
COMPLETE AIR CONDITIONING
•
VENTILATION
•
HEATING
•
COOLING
•
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been added since the first edition, treating classification of armature and field coils according to their insulation, increase of machine ratings by changes in insulation, and test methods. The book is divided into two parts: one dealing with reconnecting d.c. machines for voltage and speed changes, the other with locating and remedying faults in those machines.

MANAGING FOR PROFIT

C. E. Knoeppel, Industrial Management Counselor, with collaboration of Edgar G. Seybold, Management Consultant. McGraw-Hill Book Co., Inc., 330 West 42d St., New York. 343 pages, index. Illustrated. $3.50.

Contains working methods for profit planning and control. Recently developed profit-making tools and methods are described and explained, with the intention that they be applied to better the profit position of any business.

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ON THE CALENDAR

FEBRUARY

9–11, American Management Association, Conference on Industrial Relations, Philadelphia. Alvin E. Dodd, President, 330 West 42d St., New York.

14–19, National Electrical Manufacturers Association, Mid-winter Meeting, New York. W. J. Donald, Managing Director, 155 East 44th St., New York.

MARCH

1–5, American Society for Testing Materials. Spring Committee Meetings, Chicago. C. L. Warwick, Secretary, 260 South Broad St., Philadelphia.

15–19, National Oil Burning and Air Conditioning Exposition, Philadelphia. Cornelius F. Curtin, Exposition Manager, Care of Oil Burner Institute, 30 Rockefeller Plaza, New York.

21–27, American Ceramic Society, Annual Meeting, New York. Ross C. Purdy, Secretary, 2525 North High St., Columbus, Ohio.

23–26, American Management Association, Packaging, Packing, and Shipping Conference and Exposition, New York. Alvin E. Dodd, President, 330 West 42d St., New York.

APRIL

15–16, American Management Association, Production Conference, Detroit, Alvin E. Dodd, President, 330 West 42d St., New York.

27–29, Chamber of Commerce of the United States, Annual Meeting, Washington, D. C. D. A. Skinner, Secretary, 1615 H St., N. W., Washington, D. C.

MAY

3–7, American Foundrymen's Association, Annual Convention and Show, Milwaukee. W. F. Bornfleth, General Chairman, Care of Cutler-Hammer, Inc., Milwaukee.

10–14, National Fire Protection Association, Annual Meeting, Chicago. Franklin H. Wentworth, Managing Director, 60 Batterymarch St., Boston.

Answers to Questions

(Continued from page 72)

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ground and the other two lamps or groups burn brighter, whereas the one in the grounded line will be dark.

When a ground is indicated the circuit affected can be located by opening each branch circuit switch in turn and noticing whether the ground detector lamps return to normal. When

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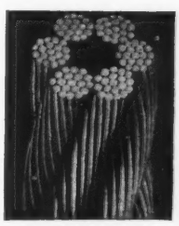

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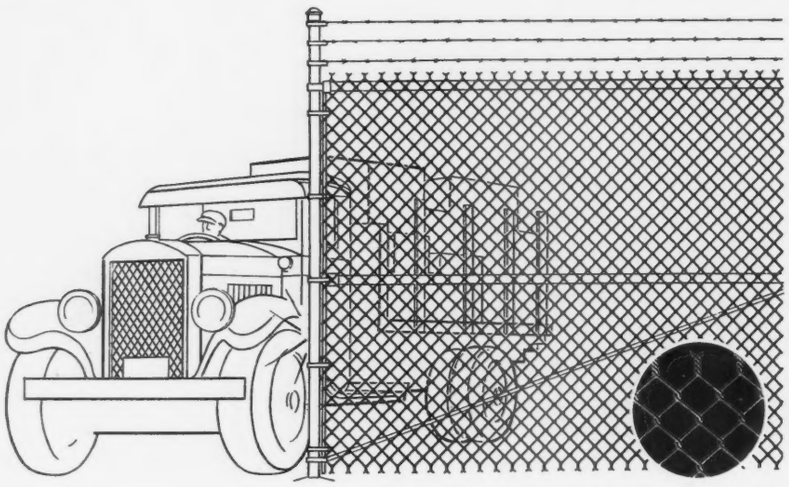

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MANAGING FOR PROFIT

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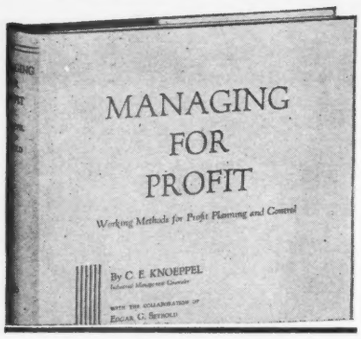

MR. KNOEPPEL, through years of professional experience, has found that unsuccessful managements are those which, as a rule, pay too much attention to selling or manufacturing *per se* and not enough to the economic fundamentals and financial considerations of business. In this book he describes the recently developed aids to management in the way of profit-making tools and methods, shows how they work, explains how they can be applied to any business to better the profit position of the business.

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this occurs, test the faulty circuit by opening each motor or other circuit connected to it and have an observer at the main board note whether the lamps change to normal.

The so-called sound test is very effective in locating grounds. It consists in sending an interrupted or high-frequency current into the system between the faulty conductor and ground and testing, by means of a telephone headset and loop, along the circuit until no sound is heard, which indicates that the grounded point has been passed.

A similar test can be made by sending a reversing direct current into the system between the faulty conductor and ground and placing a compass on the conductor or conduit. So long as the tester is between the fault and the test set the needle will oscillate; beyond the fault it will not be affected.

For the sound or compass test the circuit must be dead, whereas with other methods it is possible to make the tests with minimum interference with operation.

A portable ground detector is useful when one person alone must locate the fault, since it can be applied at every branch point and will indicate at once whether opening of the switch has eliminated the faulty circuit. The simplest portable indicator consists of lamps of suitable voltage connected as in diagram 1.

An insulation testing meter or a voltmeter can also be used for locating grounds. The insulation meter is of most use when testing equipment or dead circuits. A voltmeter can be used on live circuits. On the other hand it is not so well adapted to portable use as a lamp detector, although much depends on the ability of the user. Personally, I prefer to use lamps or the sound test.

C. O. VON DANNENBERG, *Jamshedpur, India*

Trouble from Belt Slippage

A rubber belt is used to drive a fan from a 40-hp. motor which has a crowned, cast-iron pulley. The belt is kept as tight as practicable, but at times it causes considerable trouble by slipping. I should like to know: (1) Whether there is any good way of removing the smooth, glazed surface that develops on the inner side of the belt. (2) Would it be advisable to replace this motor pulley with one that has a rougher surface? Or would it be feasible to cover the face of the present pulley with leather or canvas to give it a better gripping surface? How should such a covering be attached to the pulley? —*F.P.H.*

ASSUMING that the operating conditions are favorable, it will be advisable to replace the cast-iron pulley with a paper pulley. The latter type

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of pulley has a higher coefficient of friction and will tend to stop belt slippage. In proposing this simple solution it is taken for granted that the slipping is not so severe as to prevent starting of the fan, or cause the belt to jump off the pulley. In such an event it would probably be necessary to redesign the drive for higher power transmitting capacity.

A few light applications of castor oil, or a dressing prepared by a reputable manufacturer, will remove the smooth surface caused by slipping. These materials will soften the belt somewhat and increase its grip on the pulley, thereby reducing the tendency to slip. J. L. YOUNG, *St. Marys, Ohio.*

Operating Six Transformers in Parallel

We have three 50-kva. and three 25-kva. transformers rated at 460 volts primary and 230/115 volts secondary. They are all of the same polarity. Will someone please tell me whether it is possible, and if so, how, to parallel these transformers in order to balance the load on the three-phase feeders and equalize the load on the transformers, which will supply 115-volt lighting circuits? —G.H.P.

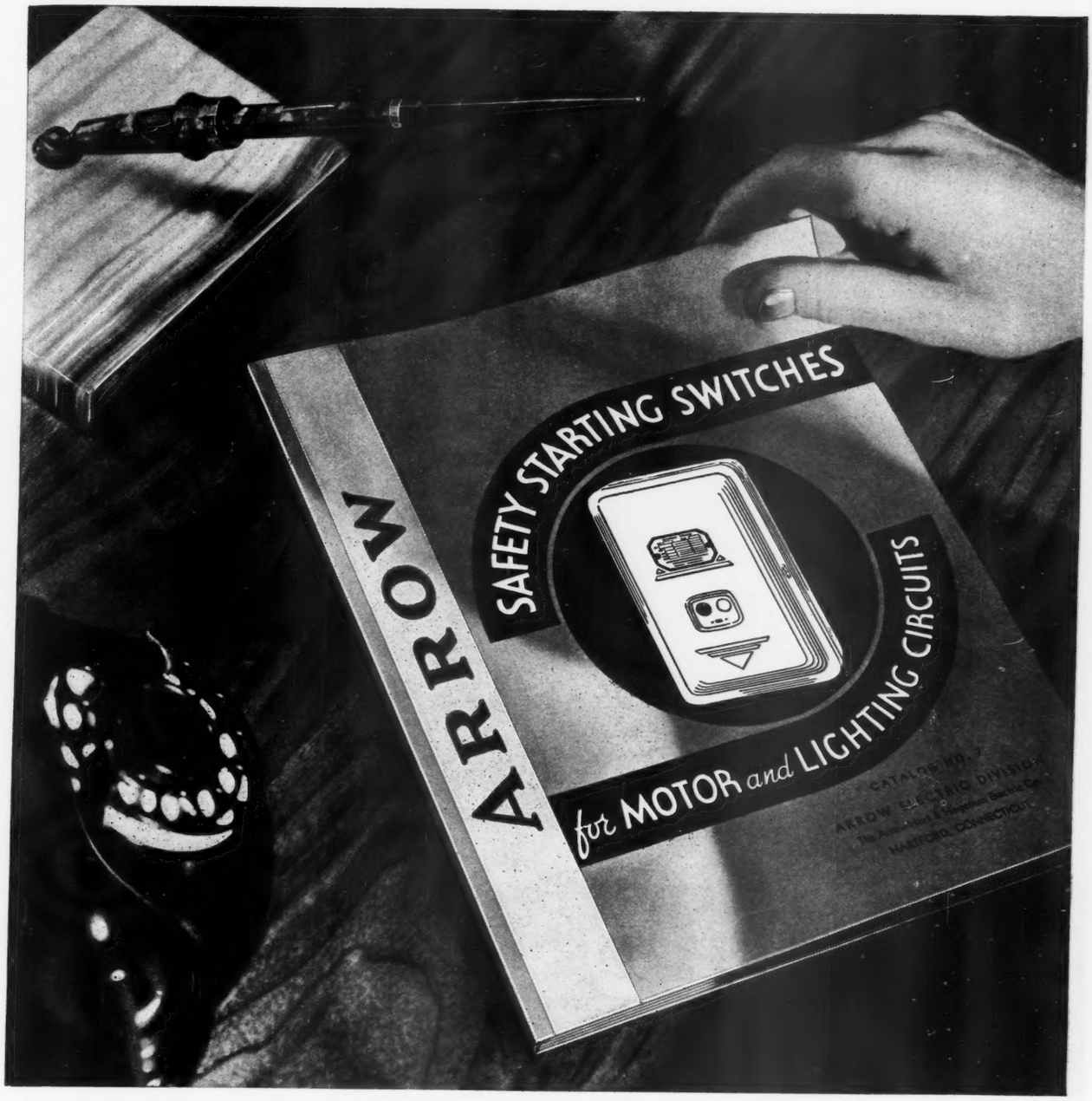
IT IS possible to get practically equal loading on a three-phase system with single-phase loads, but the only means I know of is careful arrangement of the lights to give a balanced condition. As a safeguard against slight unbalance that cannot be prevented the transformers should not be loaded beyond 70 to 80 per cent of their rating.

In this instance paralleling can be taken care of in several ways:

1. Form two delta-delta banks, one with the three 50-kva. transformers and the other with the three 25-kva. units. Place each bank near the approximate center of a lighting load equal to 70 or 80 per cent of the rating of each bank. From the secondary deltas run single-phase feeders to each group of lights whose demand is about equal to one-third of the capacity of the bank.

2. Connect only the primaries of the transformers into deltas. Do not interconnect the secondaries, but let each unit feed its own group of lights as a single-phase load. The advantage of this method over the preceding is that grounds and other troubles on one lighting circuit or transformer will not affect the other loads or units.

3. Locate each of the six transformers as a single-phase unit near the load centers of six groups of lights approximately equal to the capacities of the individual transformers. Install a three-phase, 460-volt line to feed the transformers and connect the units to give approximately equal loading per phase. The best results are ob-



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